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THE FAN-MOTOR.

The fan-motor is a peculiarly American invention. It made its appearance upon the scene about fourteen years ago and met with immediate and hearty approval. During the few years of its history it has been rapidly improved and has now reached a state of high perfection, as may be readily seen by the descriptions of the more important types which will be found in other pages of this issue.

Certainly the man who first thought of making a little breeze machine was a public benefactor. The amount of discomfort that has been relieved by the familiar whizzing fan is almost incalculable, and there can be no doubt that it has really prolonged and doubtless saved many lives. It is strange that in countries where the climate is more oppressive in the Summer months than it is in the United States even, there should not be a more widespread use of these fans. The new eastern possessions of the United States and the vast area beyond should open a large market to American manufacturers of such goods. The punkah has been in use in India from time immemorial, but its days are certainly numbered if the silent, efficient American electric fan ever becomes fashionable in that country.

It needs only familiarity with this admirable product of American invention to make it strongly demanded in certain warm regions of the earth, and American fan-makers should be wide awake to the opportunities of export offered them at the moment.

AN AUTOMOBILE EXHIBITION.

The ELECTRICAL REVIEW is informed that plans are under way for holding an automobile exhibition in New York city. From inquiries already made there seems to be some doubt in the minds of manufacturers as well as users of automobiles as to the best time of year for holding the exhibition. It seems to us that the week before the Horse Show in New York would be the most advisable time. This, for several reasons: First, at that season of the year there are a large number of strangers in New York, the majority of whom are of that class who can afford to purchase automobiles; second, the weather at that season—the latter part of October or the first part of November—is generally good; third, if the exhibition were held in Madison Square Garden the week before the Horse Show the necessary arrangements for the Horse Show would also be proper for the automobile exhibition. The basement of the Garden could be used for stationary exhibits, and the ring or ground floor could be used to exhibit automobiles in motion, which would undoubtedly form a very attractive and crowd-drawing feature. Obstacle races, speed trials and other contests could be readily arranged. The ELECTRICAL REVIEW believes the time is ripe for such an exhibition, and trusts that the gentlemen who have the matter in charge will carry the scheme to success.

NOMINATIONS FOR THE INSTITUTE PRESIDENCY.

Already a number of gentlemen have been proposed for president of the American Institute of Electrical Engineers, to be elected this Spring, and there seems an unusual degree of interest in the matter, because the new president will preside at the Summer meetings in Paris. For this reason, the choice of the Institute should certainly fall upon some man of dignity and representative standing. He will be, in a sense, the exhibit of the Institute at the Paris Exposition, and should know how to handle himself with both dignity and discretion. He should also be representative of all that is peculiar to American engineering, and he should be a man who has done real work which is respected abroad as well as at home. It is greatly to be hoped that the choice this time will fall upon some eminent engineer, who will possess also an impressive personality and the *savoir faire* that will make friends for him and the Institute abroad. It would also be well if he were able to speak French.

A GLANCE AHEAD.

It is always dangerous to prophesy, but it is hard sometimes to refrain from looking ahead at what must be the logical outcome of present situations. Looking at the status of the central station supply of electricity in New York city to-day the imagination naturally reaches ahead to a period, which can not be many years distant, when things will be very different and when the tendencies at present so strongly displayed will have eventuated in a vast difference in the operation of several important public service utilities.

In ten years from now it is reasonable to think that the elevated railway, the new underground rapid transit system and the surface railways will be united under one operative management and, naturally, operated throughout by electricity. It is not unlikely that at that period the electric light companies will be either under the same management or so closely affiliated that their stations will be worked in conjunction with those for the supply of power to the transit systems. We can see in the future, then, vast stations aggregating many hundreds of thousands of horse-power and probably all operated upon the system now coming generally into vogue—polyphase generation and transmission with converter and transformer substations. Such a general scheme, while of immense extent and representing enormous output of energy and power, would be comparatively simple and exceedingly flexible. We can imagine the city provided with perhaps a dozen or more great generating stations scattered along its water courses and all tied and connected together with link lines so that no conceivable accident could stop the supply of current for either the railways or the lights. The lighting stations could supply the railways or *vice versa*. The total consumption of power would probably reach at that time, for both purposes and for stationary motors, whose use is growing, nearly a million horsepower. With improved systems of supply and distribution the necessity for stationary engine plants in a city like New York will vanish. We can see, then, the ideal toward which many social reformers have been working—the smokeless and chimneyless city of the future, with rapid and silent methods of transit and with widespread use of the most advanced and highly developed system of lighting. The whole tendency of the present is toward the unification of public service corporations, and it is no idle thought to look forward to the day when a single management will control all of the electricity supply systems of Greater New York and thus, by combining the generating plants, produce electric current at such low prices as to extend its use and at the same time make even a temporary suspension of supply a practical impossibility.

BRITISH ELECTRICAL ENGINEERS IN THE SOUTH AFRICAN WAR.

A query was made in these columns some weeks ago concerning the whereabouts of the force of volunteer electrical engineers attached to the British army. It appears that their absence from the front is due to their having been entangled in the meshes of red tape emanating from the British War Office. But now a small detachment of fifty highly trained men under Major Crompton is to be sent to the scene of hostilities with searchlights and other electrical apparatus. The very inadequate amount of three thousand pounds sterling has been allowed by the War Office for apparatus, but it is thought, as our British letter states, that this amount will be supplemented by subscription among members of the profession.

The value of such a corps of trained men, accustomed to meeting and handling emergency problems, can not for a moment be doubted. They will, if they have a chance, prove their merit in such a way as doubtless to foster hereafter the training of such troops in a more liberal and satisfactory manner than has been practiced hitherto. Major Crompton is well known in electrical circles, having been prominent in the designing and manufacture of electrical apparatus since the inception of the industry. His subordinates are partly engineers and partly artisans of the first class, and there can be no doubt that these men will render an account of themselves that will reflect credit upon their profession.

THE DECISION IN THE WASHINGTON TELEPHONE CASE.

The significance of the decision by Judge Barnard, of the District of Columbia Supreme Court, in the test case recently brought against the Chesapeake & Potomac Telephone Company by a number of its subscribers, is of very far-reaching importance. On January 30, 1898, an act of Congress was passed fixing the maximum rate for the use of telephones in the District of Columbia at fifty dollars per year. The telephone company disregarded this act and naturally suits and other legal difficulties followed, culminating in the decision just rendered which declares the act of Congress unconstitutional. This is an affirmation from a court of competent jurisdiction of the simple principle that the price on a commodity of whatever kind can not be justly fixed by any legislative act. So far as its direct bearing on the telephone industry is concerned, it is as important and as useful a precedent for the independent companies as it is for the more directly interested Bell corporation.

CATALOGUES.

The catalogues published by numerous electrical manufacturing concerns in the United States are models of artistic excellence. It has come to be recognized in these latter years that the same rules which apply in the selection of a salesman must apply equally, and perhaps with greater force, in the preparation of a catalogue or price list illustrating the goods manufactured. It must present a neat and attractive appearance and it must not be marred by any cheapness of manufacture or dress. In other words, the impression created by a beautiful pamphlet goes a long way toward establishing in the mind of its reader an appreciation of the goods which it describes. At the same time the new processes of illustration have become relatively inexpensive and there is no longer any excuse for poor pictures or for any lack of them. It is worth the serious consideration of any concern which desires to put out a circular or catalogue to study the subject with the same care that it would use in the selection of a man to represent it on the road. In a sense its catalogue is its salesman. It travels into offices and it must speak for itself when it has arrived.

Mr. Charles J. Glidden.

Mr. Charles J. Glidden, president of the great Erie telephone system, the largest in the United States, and with one exception — that of Great Britain — the largest in the world, was born in Lowell, Mass., August 29, 1857. He was messenger boy in the office of the Northern Telegraph Company in 1872, and manager at Manchester, N. H., of the same company in 1873. The old Northern Company was leased to the Franklin and later to the Atlantic & Pacific Company, which in 1876 became part of the system of the Western Union Telegraph Company. Professor Bell, the inventor of the telephone, came to Manchester to test the telephone in 1876, and Mr. Glidden arranged the test, using the Atlantic & Pacific wires from Smyth's Hall, Manchester, to the Music Hall in Boston. The test was witnessed by a large audience and was a complete success.

Mr. Glidden entered the telephone service, putting in private lines, in the Spring of 1877, and during the Summer commenced the canvass for subscribers to the Lowell, Mass., telephone exchange which he built in the Spring of 1878. In 1879 he built the first long-distance line to Boston. That year, with two other Lowell gentlemen, he commenced buying up all the smaller Bell companies in New England, and after successfully managing them until 1883 they were merged into the New England Telephone Company. In this year the Erie was formed by consolidating under one management the telephone interests in Arkansas, Texas, Minnesota, Dakota and Cleveland, Ohio. The Erie started off with less than 9,000 subscribers in the entire territory. Later the states of Wisconsin and Michigan were added, and at the present time the Erie Company operates 110,000 subscribers and over 200,000 miles of wire, of which 80,000 miles are used for long-distance service. The aggregate capital of the sub-companies of the Erie is about $22,000,000, and the plant is being increased at the rate of 50,000 subscribers annually, with a corresponding growth of long-distance lines at a cost of $6,000,000. The Erie Company owns real estate in 60 cities now valued at $1,500,000. The gross income of the Erie for 1900 is estimated at $5,000,000, which will be an increase of $1,500,000 over 1899, and the company will close the year with 150,000 subscribers and 250,000 miles of wire, not including the recent purchase of 14,000 independent subscribers and 7,500 miles of toll-line and 15,000 miles of exchange line.

Mr. Glidden has only one other enterprise in which he is interested, and that the Traders National Bank, of Lowell, of which he is president. The bank opened for business July 1, 1892, with a deposit of about $55,000. Now the deposit average $3,000,000, with a surplus of $200,000, equal to the capital of $200,000. Mr. Glidden is a thorough believer in advertising, and advertises in every daily paper in the entire Erie system. He was the pioneer in advertising the telephone, and takes many an extra page during the year, not only in local dailies but in the electrical journals of the country. The Erie's advertising department occupys three large rooms in the executive offices at Lowell and is in charge of an able manager and corp of clerks. The Erie's advertising account is about $100,000 annually. Probably no single individual in the field has done more to bring the undoubted advantages of the telephone to the attention of non-users, and the returns to the Erie system, through Mr. Glidden's enterprise, have been pronounced and highly satisfactory.

MR. CHARLES J. GLIDDEN, PRESIDENT OF THE ERIE TELEPHONE SYSTEM.

PERSONAL.

Mr. H. Ward Leonard, of the Ward Leonard Electric Company, Bronxville, N. Y., is visiting Paris.

Mr. W. E. Cooke, of J. G. White & Company, New York city, sailed for London last Saturday on the Lucania.

Mr. H. D. Emerson, of Alliance, Ohio, who is interested in a number of electrical enterprises, has been spending the past week in New York city.

Mr. J. R. Lovejoy has been appointed manager of the railway and lighting departments of the General Electric Company. He also is retained in his former position as the manager of the supply department.

Proposed Electrical Enterprise in Venice.

At the request of a New York export association (to which the letter has been forwarded), United States Consul Johnson sends from Venice under date of December 19, 1899, copy of a memorandum from one of the engineers interested in the projected company for supplying electrical energy to Venice, as follows:

At the request of the Chamber of Commerce, of Padua, for information regarding the utilization of the waters of the River Cellina and part of the River Piave for the purpose of transferring electrical energy to Venice and vicinity, the following is submitted:

The Cellina, with an annual average capacity of 423.7 cubic feet per second, and in two falls of the combined height of 328 feet, is able to supply Venice with electrical power equivalent to 10,000 horse-power at a distance of 59 miles. The government is ready to grant the concession and the work can be begun immediately.

The Piave offers more favorable conditions. From the Piave would be derived 529.7 cubic feet per second; that is to say, one-third of its capacity in the dry season, which would serve to feed Lake Santa Croce at a level of 1,246 feet above the sea. This lake, which acts as a reservoir, contains 3,531,660,000 cubic feet of water, of which 706,332,000 cubic feet would always be at the disposal of the hydraulic motors. The falls in ths system would be two, with a combined height of 738 feet. It would be possible to include a third fall 229.6 feet high. The water of overflow would serve for the irrigation of the plain between the Piave and the Livenza. From the two falls of 738 feet to Venice, 43 miles distant, 27,000 horse-power can be conducted. By making use of the third fall, this figure could be increased by 8,400 horse-power.

The existence of Lake Santa Croce will enable the energy to be doubled—that is to say, make it 70,000 horse-power—during the hours of work. Another distribution from the Piave will be provided during the night. Application has been made for the government concession, but the concession will not be obtained for at least a year.

A private company has been formed to carry on operations on both of these rivers and is now negotiating with various banking houses for the necessary capital. The names of the prime movers in the enterprise are as follows: Counts N. and A. Papadopoli, Venice; Commendatore Giuseppe Da Zara, Padua; engineers, Ernesto Breda, Milani and Colle, care of the above.

THE POLYPHASE INDUCTION MOTOR.*

BY RALPH D. MERSHON.

To many men in electrical work the induction motor is an object of more or less mystery. Of the theory of the direct-current motor they have at least the knowledge which enables them successfully to use and care for that piece of apparatus, but of the action of the induction motor they know little. Even in the case of many who have had experience in the operation of induction motors, knowledge is limited to the fact that when in order and properly connected to its circuit it runs and carries its load. This condition of affairs is largely due to the fact that most discussions of the theory of the induction motor involve more or less of mathematics or complicated diagrams, which are not especially interesting or agreeable to many; besides, such discussions rarely furnish a basis for a working theory which, above all, the practical man is after.

I shall endeavor to take up the salient points in the theory of the induction motor in a way which will involve neither mathematics nor complicated diagrams, and which will furnish the basis of a practical working theory; such a theory as is sufficiently complete for those not actually designers of this class of apparatus.

You are doubtless familiar with the experiment due to Arago which is illustrated in Fig. 1. D is a disk of copper free to revolve upon a jeweled bearing at its centre. NS is a bar magnet suspended over the disk. If now the magnet be made to revolve about its point of suspension, the disk will also begin to revolve and will finally acquire a speed approaching, but not equal to, that of the magnet. If instead of revolving the magnet we revolve the disk the magnet will acquire a speed approaching that of the disk.

Let us inquire into the cause of these actions. We know that if a conductor be moved across a magnetic field, or, what amounts to the same thing, if the magnetic field be moved so as to sweep across the conductor, the conductor will have generated in it an electro-motive force. If the conductor form a part of a closed circuit, this electro-motive force will cause a current to flow in the circuit, the strength of the current depending upon the magnitude of the electro-motive force, and the resistance of the circuit. We have in Fig. 1 the magnetic field—that due to the magnet NS—and the disk which, being made of copper, is a conductor. By revolving one of the elements, either disk or magnet, we cause the conductor to cut lines of force. There is, generated in the conductor, the disk, an electro-motive force, or rather electro-motive forces, and if these electro-motive forces can find closed circuits in the disk, currents will flow. There are in the disk an indefinite number of closed circuits, as an inspection of Fig. 2 will show. Here we are looking down upon the magnet and disk of Fig. 1, and the magnet is supposed to be rotating at a uniform speed in the same direction as the hands of a watch. At any given instant we may suppose that there exist in the disk the four elementary circuits, A_1, A_2, B_1, B_2, shown in Fig. 2. These are the circuits with which we are concerned at a given instant. At the next instant we must consider four other elementary circuits, slightly displaced from those shown in Fig. 2 in the direction of the rotation of the magnet, because as the magnet rotates it changes its position with reference to the disk affecting successively different portions of the latter. The disk may, therefore, be considered as being made up of an indefinite number of overlapping circuits, four of which may be considered as active at the instant when the magnet bears the relation to them which in Fig. 2 it bears to the circuits A_1, A_2, B_1, B_2. Those portions of the circuits A_1, A_1, B_2, B_2, which are lying immediately below the magnet, are being cut by lines of force and are having, therefore, electro-motive forces generated in them. These electro-motive forces and the currents due to them in the elementary circuits are in the directions shown by the arrows. It should be noted, that if by any means the disk be made to rotate at the same speed as the magnet the relative position of the disk and magnet will not change, and there will be therefore no electro-motive force generated and no current will flow.

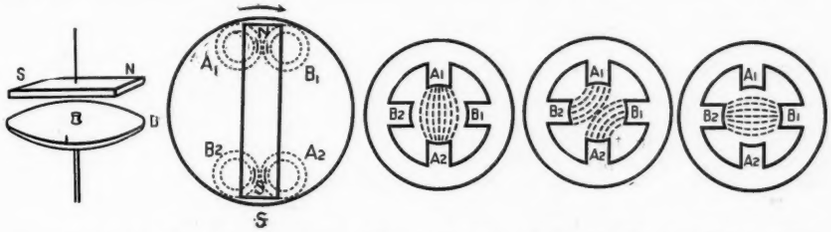
So much for the currents in the disk. The next question is why should the generation of these currents by the rotation of the magnet cause the disk to rotate? In order to explain this let us recall Lenz's law. This law states that if the number of lines of magnetism in a coil of wire or in any closed circuit be changed, there will be generated in that circuit, while the change is taking place, a current which will have such a direction as will tend to oppose the change producing it. That is to say, if a magnet be thrust into a closed coil, or if being in the coil it be withdrawn, a current will be generated which will oppose the motion. In the second case, where the magnet is withdrawn from the coil, the current will be in such a direction as will tend to hold the magnet in the coil, or, what amounts to the same thing, as will tend to move the coil after the magnet. In the first case the current will tend to keep the magnet from entering the coil, or to push the coil away from the magnet. The magnet need not, however, be actually thrust into the coil. It may be merely brought up into the neighborhood of it, providing its lines of force cut the coil. Further, it does not make any difference how or from what direction the magnet is brought up to the coil, whether from one side or whether along the axis of the coil. So long as its lines of force cut the coil every movement of the magnet will be accompanied by the generation of current which will tend to oppose its movement. In the elementary circuits shown in Fig. 2 the magnet is just leaving the circuits A_1 and A_2 and just coming over the circuits B_1 and B_2. The former circuits have generated in them currents which tend to keep the magnet from moving away from them; that is currents which tend to pull the circuit after the magnet. The latter circuits have generated in them currents which tend to keep the magnet from coming over the circuits; that is, currents which tend to push the circuits ahead of the magnet in its motion. The result is a tendency toward rotation of the disk and if free to move it will rotate. The faster the disk rotates, that is, the more nearly it approaches the speed of the rotating magnet, the less will be the relative speed of the magnet and disk, and consequently the less will be the speed at which the lines of force due to the magnet will cut the disk. But the electro-motive force, and therefore the current, generated in the disk, diminishes as the rate of cutting of lines of force diminishes. Therefore the currents generated in the disk will be less as the relative speed of the magnet and disk diminish. That is, the more nearly the speed of the disk approaches that of the magnet the weaker will be the currents generated in the disk. The weaker the currents are in the disk the less the torque or drag which the magnet exerts on the disk to keep it in rotation. Starting from rest, therefore, the disk will gradually increase in speed until the torque or drag exerted on it by the magnet is just equal to that necessary for overcoming the friction of rotation. It is clear that the disk can never attain the same speed as the magnet, but must run at a somewhat lower speed. Its speed must be enough lower so that the rate at which the lines of force, due to the magnet, cut the disk will produce currents of sufficient strength to give the torque necessary for overcoming friction. It follows that if, having attained a steady speed. the disk have its friction increased by any means its speed will fall to such a point that the currents generated in it are just sufficient to produce the torque necessary for the increased friction load, and on the contrary, if having attained a steady speed the friction be diminished, the disk will speed up until the currents induced in it are diminished to such a value as is just sufficient to produce the torque necessary for the decreased friction load.

So far we have considered a rotating magnetic field obtained by actually rotating a magnet, but it is clear that so far as the disk is concerned it makes no difference how the rotation of the magnetic field acting upon it is produced. The actions discussed above will be produced by any rotating field, and if we can produce such a field by any other means than that of actually rotating a magnet, we should expect the disk to be affected in precisely the same way as it is by the rotating magnet.

Consider the four-pole field shown in Fig. 3. Suppose the poles A_1, A_2 and B_1, B_2 are wound with coils by passing current through which the poles may be magnetized. Suppose now the poles A_1 and A_2 be magnetized, A_1 being made a north pole and A_2 a south pole. There will then be produced a magnetic field between the poles A_1 and A_2 as shown by the dotted lines in Fig. 3. Suppose now

*Abstract of a paper read before the Northwestern Electrical Association.

the current magnetizing the poles A_1 and A_2 to continue flowing and the poles B_1 and B_2 be magnetized so that B_1 is a north pole and B_2 a south pole. The magnetic lines will then pass from the north pole A_1 to the south pole B_2 and from the north pole B_1 to the south pole A_2 as shown in Fig. 4. Suppose now the current magnetizing the poles A_1 and A_2 be broken and that magnetizing B_1 and B_2 to continue flowing. Then the magnetic lines will pass between B_1 and B_2 only, as in Fig. 5, B_1, as stated above being a north pole and B_2 a south pole. Consider now what has happened in Figs. 3, 4 and 5. We started with A_1 a north pole and A_2 a south pole in Fig. 3; in Fig. 4 A_1 and B_1 were north poles and A_2 and B_2 south poles; in Fig. 5 B_1 was a north pole and B_2 a south pole. The magnetic field has been shifted from A_1A_2 to B_1B_2—one-quarter of a revolution—in a way somewhat similar to that which it would be shifted if a magnet were rotated from the position A_1A_2 to the position B_1B_2. The comparison would be still more nearly identical if the magnetizing current

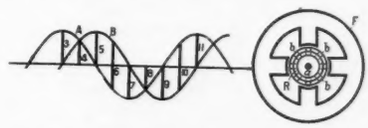


FIGS. 1, 2, 3, 4 AND 5.—THE INDUCTION MOTOR, SHOWING DISK AND MAGNET EXPERIMENT AND ROTATING FIELD.

of A_1A_2 were gradually decreased from its maximum value to zero and that of B_1B_2 gradually increased from zero to its maximum value instead of being changed suddenly by making and breaking the circuit as described above. If these changes were made gradually Fig. 4 would represent the condition where the current magnetizing A_1A_2 had diminished from its maximum value to a certain value intermediate between its maximum and zero, and the current magnetizing B_1B_2 had increased from its zero value until it had the same strength as the decreased current magnetizing A_1A_2. Increasing and decreasing the currents gradually in this way would cause the condition which holds in Fig. 3 to merge gradually into that of Fig. 4, and the condition which holds in Fig. 4 to merge gradually into that of Fig. 5, instead of being attained by jumps as would be the case if the currents were simply made and broken as at first described. It is evident that by continuing this procedure the magnetic field may be made to rotate continuously around the space included between the poles A_1, B_1, A_2, B_2.

So far we have assumed that the currents producing these magnetizations are direct currents, whose values, controlled by rheostats or otherwise, are made to vary between zero and a certain maximum, and from this maximum to zero again, at which point the connections are reversed and the current then increased to its maximum value in the opposite direction. It is not necessary, however, to use direct currents manipulated in this laborious fashion, as a two-phase alternating-current generator will supply currents which will pass through precisely the same values as those which we have supposed the direct currents to pass through. Fig. 6 shows two curves which may be taken as representing the currents supplied by the two circuits of the two-phase generator. The significance of Fig. 6 is as follows: Points on the line *xx* represent different positions of the generator armature producing the currents whose curves are A and B, just as points on the horizontal line in a steam engine indicator diagram represent different positions of the piston; the lengths of the lines 3, 4, 5, etc., represent the strength of the current flowing for the position of the armature to which they correspond, just as in an indicator diagram vertical lines represent steam pressure for the positions of the piston to which these lines correspond. For instance, the length of the line 3 represents the strength of current flowing in one direction, which we will call the positive direction, in the circuit of curve A, while the line 7 represents the strength of current flowing in the opposite or negative direction in the circuit of A. Similarly the lines of 5 and 9 represent positive and negative currents in the circuit of B. Some lines, such as 4 and 5, represent currents in both of the circuits These lines must be considered as made up of two superposed lines, one for the circuit of A and one for the circuit of B. Referring again to the Figs. 3, 4 and 5, suppose that the poles A_1, A_2, are magnetized by the current represented by the curve A, and that B_1 and B_2 are magnetized by the current of the curve B. Suppose that when the current of curve A has a positive value its direction in the coils magnetizing A_1, A_2 is such as to make A_1 a north pole and A_2 a south pole. Then when the current of curve A has a negative value, A_1 will be a south pole and A_2 a north pole. Similarly when the current of curve B is positive, B_1 will be a north pole and B_2 a south pole, and when the current is negative B_1 will be a south pole and B_2 a north pole. Now, if we carefully follow out the values of the currents in circuits of A and B and their resultant magnetizations we will find that the magnetizations pass through the same changes as those which were described above in the case of the direct current.

The four-pole field shown in Fig. 3 will, therefore, if it have its poles properly wound with coils to which are supplied two-phase alternating current, produce a rotating magnetic field. If in this field we place a closed conductor, free to rotate, we should expect it to behave as does the copper disk, above described, in the presence of the rotating magnet. If in this field we should place, instead of an armature, a solid copper cylinder provided with suitable shaft and bearings we should expect this cylinder to rotate and to be capable of carrying more or less load as a motor. If, however, instead of the solid copper cylinder we place in the field of Fig. 3 an iron cylinder, properly mounted on a shaft and bearings and having longitudinal holes or slots at its periphery in which are wound short circuited coils, or in which are placed copper bars short circuited by rings at each end of the iron cylinder, the result obtained will be better than that in the case of the copper cylinder, since the iron cylinder will furnish a better path for the lines of force. Let Fig. 7 represent a motor constructed in this way. F is the four-pole field which, since it is acted upon by alternating currents, must be laminated, and *a* is a laminated iron cylinder provided with a shaft and bearings (not shown); *bbb*, etc., are copper bars placed in longitudinal slots in the periphery of the cylinder A, which we will call for the present the armature. The terms armature and field will for the present be used in describing these two elements, although as will be shown later, it were better to use the terms primary and secondary. The copper bars *bbb* are short-circuited at each end of the armature by a ring, R, to which they are soldered or bolted. We have now a two-phase induction motor which will behave in a good deal the same way as the copper disk which has been discussed. Instead of the elementary circuits shown in Fig. 2 we have the copper bars and the closed circuits which they make through the end ring, and instead of the rotating magnet we have a rotating magnetic field produced by alternating currents. Suppose the armature A to be at rest. On closing the switches which connect the windings of the field F with the two-phase generator, a rotating field will be produced which will induce currents in the closed circuits formed by the bars and the short circuiting end rings of the armature A, and these



FIGS. 6 AND 7.—THE INDUCTION MOTOR.

currents will have such a direction as will tend to overcome or nullify the motion of the magnetic field producing them. That is, the direction of these currents will be such as will tend to produce a rotation of the armature A, which, if left free to move, will begin to rotate and gradually increase in speed of rotation until its speed approaches that of the rotating field which is sweeping around the interpolar space of the four-pole field F. As in the case of the disk and rotating magnet, the final speed to which the armature settles down will depend upon the friction of its bearings. The greater the speed which it acquires the less will be the relative speed between it and the magnetic field, and consequently the weaker will be the cur-

rents induced in the short-circuited winding. Its speed will, therefore, as in the case of the disk, increase to the point where the difference between its speed and that of the rotating field induces currents of strength just sufficient to produce a torque necessary for overcoming friction. If by means of a pulley and belt the armature be made to carry load it will slow down to such a point that the difference between its speed and that of the rotating field is sufficient for the generation in the short-circuited winding of currents of sufficient strength to produce the torque necessary for carrying the load. The difference between the speed of the armature A and that of the rotating field is generally designated as the "slip" of the motor, and the statements made above may be more concisely put by saying that for a given motor the amount of slip will depend upon the load carried by the motor, being greater as the load is greater and diminishing when the load diminishes. In commercial motors the slip is not quite proportionate to the increase in load. It increases somewhat more rapidly for a given increase of load when the motor is heavily loaded than when it is lightly loaded. The departure from proportionality is not, however, in a good motor great between no-load and the load for which it is rated. Note that in the case of the motor, as in the case of the disk, the slip can never become zero; that is the speed of the armature can never become equal to that of the rotating field, because even with no external load there must be a great enough slip to generate in the armature A currents of sufficient strength to produce the torque necessary for overcoming friction.

From what has gone before it is clear that the speed of the armature A is equal to the speed of the rotating field less the slip. Let us see on what the speed of the rotating field depends.

Refer to Fig. 6 representing the two-phase alternating currents supplied to the motor. It has been shown that in passing from the values of the currents shown by the line 3 to the values indicated by the line 11 the rotating field is caused to make one complete revolution. Now from line 3 to line 11 is one complete cycle or period. The current A has started with a positive maximum value at 3, fallen to zero at 5, attained the negative maximum at 7, fallen to zero at 9 and finally attained at 11 a positive maximum equal to that at which it started. In other words, both of the curves have started from certain respective values at 3 and have returned again to those values at 11. It is clear, therefore, that a complete cycle causes one complete rotation of the magnetic field in such a motor as is shown in Fig. 3. Now in such a motor each circuit from the generator supplies current to a pair of poles. The circuit in which the current A, Fig. 7, flows magnetizes the poles A_1 and A_2; the circuit in which the current B flows magnetizes the poles B_1 and B_2. Therefore, in a two-phase motor which has a pair of poles for each circuit of the two-phase generator supplying the motor, there is one complete rotation of the magnetic field for each cycle of the alternating current supplied to it. If such a motor is supplied with alternating currents having a frequency of 60 cycles per second, or 3,600 cycles per minute, the magnetic field will rotate at 3,600 revolutions per minute. If it is supplied with a current having a frequency of 25 cycles per second, or 1,500 cycles per minute, the field will rotate at a speed of 1,500 revolutions per minute. The speeds above given are those of the rotating magnetic field. The corresponding speeds of the motor itself when loaded are equal to the speeds given diminished by the slip of the motor at full-load. If the full-load slip of the motor were in each case, say 10 per cent, then each of the above speeds would have to be diminished by 10 per cent in order to arrive at the full load speed of the corresponding motor. In commercial motors the slip at no-load is so small, that is to say, the no-load speed is so nearly that of the rotating magnetic field, that the speed of the field is generally given as that of the motor at no load.

The above gives the method of obtaining the speed of the magnetic field for a motor having one pair of poles for each of the circuits supplying it. If, however, there are more than two poles to each circuit, when successive poles of the same circuit interchange their values, the magnetic field will not have made one-half a revolution, because successive poles of the same circuit will not be a half-revolution apart. Take the case of an eight-pole field, two pairs of poles, that is four poles, being magnetized by each of the two-phase circuits. In this case adjacent poles of the same circuit are 90 degrees instead of 180 degrees apart. Therefore, when successive poles of the same circuit have interchanged their signs the magnetic field will have swept through only 90 degrees instead of 180 degrees, or through one-half the angle which it would in Fig. 3. Since in Fig. 3, having one pair of poles to each circuit, a complete cycle produces a complete revolution of the magnetic field; in the case of a motor having two pairs of poles to each circuit a complete cycle of the current will produce only half a revolution of the magnetic field. Similarly in a 12-pole frame that is one in which there are three pairs of poles for each circuit, an interchange of the signs of the adjacent poles of the same circuit will mean only one-sixth of a revolution of the magnetic field instead of one-half a revolution, as in Fig. 3, and a complete cycle of the currents supplying the motor will mean, therefore, only one-third instead of a complete revolution. The speed of rotation of the magnetic field will be equal to the frequency of the currents divided by the number of pairs of poles supplied by each circuit. For instance, in the case of a 12-pole frame, that is a field having six poles or three pairs of poles to each circuit, the speed of the rotating field with alternating currents having a frequency of 60 periods per second, or 3,600 periods per minute, will be 20 revolutions per second, or 1,200 revolutions per minute. Although so far only a two-phase motor has been treated, this rule for obtaining the speed of the magnetic field will apply to either two-phase or three-phase motors. Although the description given of the action of the induction motor assumes that the rotating field is produced in the stationary element, this is not necessarily the case. Instead of the construction shown in Fig. 7 the rotating member might receive, by means of slip rings, the currents from the line and have the rotating field produced in it. The short-circuited winding would then be on the stationary element. The performance of such a motor would be precisely the same as that which has been described. The rotating field would still act in a direction to drag the short-circuited member after it, but since the member producing the rotating field is the movable one, the result would be a forcing of the movable member around in a direction opposite to that in which the magnetic field rotates.

(To be concluded.)

Electric Headlights on the Delaware, Lackawanna & Western Railroad Locomotives.

The Scranton, Pa., shops of the Delaware Lackawanna & Western Railroad have just equipped six locomotives with electric headlights. Mr. J. W. Fitz Gibbon, the superintendent of motive power and machinery, writing to the ELECTRICAL REVIEW, says: "I have had a great deal of experience with this type of headlight on the Rock Island Road, and find it is practicable; it has proven very satisfactory in service. Of course, it requires a little more than the ordinary intelligence to look after the repairs and proper maintenance of same, but after the men are educated up to this standard we will have no trouble with the headlights."

Instead of the oil lamp in the usual headlight there has been substituted an electric arc light of 6,000 candle-power, and in its beam a newspaper can be read a third of a mile distant on a straight track. It is a veritable searchlight, a safety appliance to guard against collisions, accidents and other mishaps incidental to railroad life.

In addition to the arc headlight, the two "blizzard" lights on either side of the front end of the boiler are illuminated by electricity and there are two incandescent lamps in the engineer's cab, and five underneath the running boards and boiler to permit the engineer and fireman to oil and clean the engine and make what repairs are necessary without an oil lamp or torchlight.

The engine is wired similar to a building and the current is supplied by a turbine engine and dynamo, capable of supplying 35 volts. The dynamo is 18 by 26 inches in size and is stationed on top of the boiler, just outside the rear end of the cab.

The appliance can be operated with the utmost safety, and after an employee becomes used to it, he doesn't want the old style. Men who have tried the lights as an experiment, have offered to pay for the equipment of their engines when the company failed to provide them.

ELECTRIC FANS AND FAN MOTORS FOR 1900

The growth of the fan-motor industry is one of the most astonishing features of the general progress of the electrical arts. Only about 14 years ago the first desk fan made its gentle breeze and blew itself into sudden favor. Here was something that the comfort-loving American people wanted—a sort of pocket cyclone to ameliorate the perspiring unpleasantness of a summer day. In a few years the hum of the little fans was heard throughout the country. New ideas in fans were introduced. They were made to hang from ceilings, to go in brackets screwed to walls, to whirl at the tops of ornamental posts. Regarded at first as a luxury, it was soon seen that they were a necessity. The demand for them brought out a liberal supply, and the prices for fans soon descended to that reasonable point where anyone can afford one, and manufacturers can still find profit in making them. In the greater cities, their use has grown so much that they furnish a very respectable proportion of the custom of electric lighting stations during the warmer months.

In the following columns are described and illustrated the more prominent types of electric fans, the designs being those prepared by the various makers for the Summer of 1900. With this array to choose from, the man who doesn't keep cool or keep his building ventilated this Summer can surely have only himself to blame.

Lundell Electric Fans.

The Lundell fan for 1900, as made by the Sprague Electric Company, New York

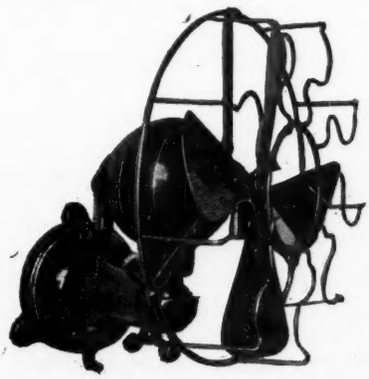


FIG. 1.—LUNDELL BRACKET FAN.

city, has the same degree of excellence that has made it so popular in the past. There is a slight change in the form of the motor and guard which improves the general appearance, if such a thing be possible. Every feature of the Lundell fan is attended to by an expert, and in this way mechanical perfection is attained. The fundamental principles of construction are protected by patents covering the single-field coil. The single-field coil energizes both poles and is entirely enclosed, making it ironclad. The efficiency of the Lundell motor has always been exceptionally high, and it has made it possible to increase the pitch of the fan blades so that they will drive a large volume of air at a given speed without an increase of current. The actual current consumption of a 12-inch fan running at its highest speed, moving the maximum amount of air, is only .45 ampere on a 115-volt circuit.

The energizing coil is circular in shape, and occupies the space inside the hollow

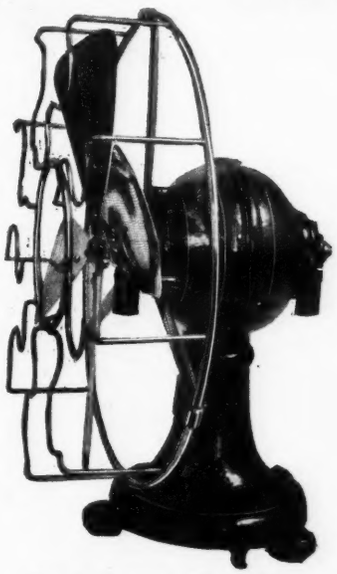


FIG. 2.—LUNDELL DESK FAN.

frame of the motor, embracing closely the pole-pieces, and thus magnetizing them directly, shortening the magnetic circuits and reducing the magnetic leakage to a minimum. This economizes the number of ampere turns necessary to energize the magnetic field, and yet provides sufficient elasticity of the field-circuit to permit all needed speed regulation by varying the field strength. The field coil, being circular in shape, is wound on a former and is perfectly insulated, taped and finished.

The commutator is composed of a proper number of bars of copper, hard drawn, very carefully insulated from each other, and of such dimensions as to insure ample capacity to carry the required current without excessive heat. The completed commutator is solid, runs true and very smoothly. Although securely fastened to the shaft which carries the armature it may be easily and quickly removed if necessary.

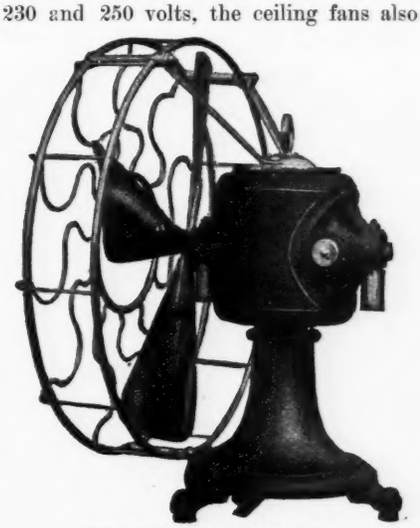
The bearings are of ample dimensions and of the self-oiling type. They are so arranged that they may be easily cleaned and inspected. A rheostat in the base of the motor-stand regulates the speed so that the user can get just the amount of breeze needed.

These fans are finished in black japan, polished brass and nickel plate. Field frames and bases can be supplied at small extra cost in any colors desired, such as white and gold, green and gold, etc.

Paragon Electric Fans.

The Paragon fan for 1900 embodies many meritorious changes in design bearing directly upon the questions of durability, power consumption and general appearance. The Paragon line this year includes both 12 and 16-inch fans, in any finish, standard being a highly effective dark bottle-green with gold striping; also 12 and 16-inch bracket fans with a truly universal joint, as distinguished from the joint so commonly used giving only an up and down motion. Ceiling fans are made in three grades, from the plain japan finished, for factory use, to the highly ornamental decorative brass finished for hotel and office.

All of the above are wound for 115, 220, 230 and 250 volts, the ceiling fans also



THE PARAGON FAN MOTOR.

for 500 volts, and are adapted to operate satisfactorily on circuits five per cent above or below their rated voltage.

In this season's model, by expending much skill, the power consumption has been reduced by 25 per cent, the volume of air moved remaining the same as formerly. All magnetic joints having been dispensed with, losses due to resistance

and heating have been rendered negligible. The armature is built up with plates of the finest grade of electric steel, assembled and riveted upon a brass tube, thus avoiding the use of clamping nuts, and their liability to work loose. The core is thoroughly insulated and, after winding, the whole is saturated with insulating varnish and thoroughly baked, each armature passing two inspections for insulation. Rectangular carbon brushes are used, their advantage over the round or pencil brushes being that they can not turn in the holder, but when once fitted to the commutator must always maintain an even contact of the full area of the brush.

"Wick-feed" oilers have been used for years by various manufacturers, but it has been found that the wick had a liability to buckle and stick in the cup. This objection has been eradicated by the use of a tube embracing the wick, and of sufficient length to support it in proper alignment, and thus with the self-aligning bearing give ample lubrication and long life.

The controlling resistance used is of a special high resistance wire wound upon an asbestos tube, which permits of the necessary expansion and contraction, due to heating and cooling, which construction this company has found to be much superior to the use of porcelain or other rigid material. This resistance is supported upon a suitable porcelain base, no fibre or other material influenced by heat being used. The controlling lever has three running steps, giving one-half speed, three-quarter and full speed, and is so constructed as to give an indication perceptible to the touch in passing from one step to the next.

While this apparatus is claimed by the makers to require a minimum of repairs, still sight has not been lost of the fact that it must at times be overhauled, and this can be accomplished with the greatest convenience, for by loosening two screws the front of the motor can be withdrawn, thus making the whole inside accessible, after which both the armature and field coils may be removed without further disturbance of any part. These fans are manufactured by the General Incandescent Arc Light Company, New York city.

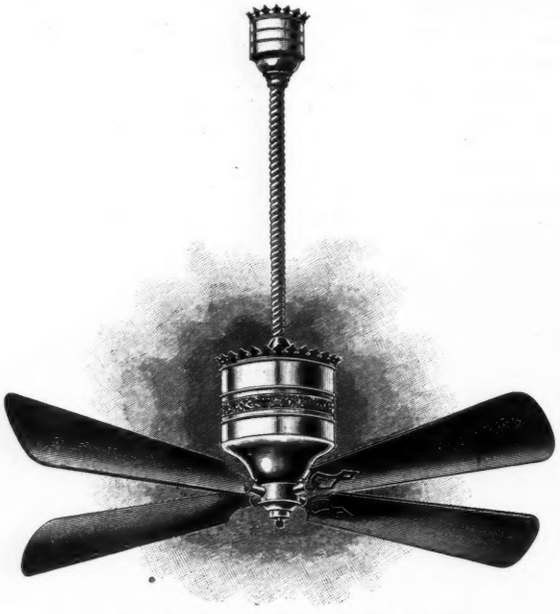


FIG. 2.—DIEHL 4-BLADED CEILING FAN.

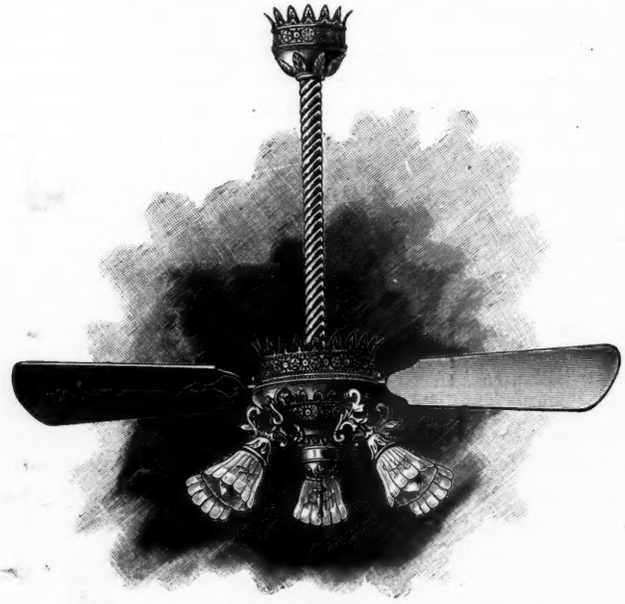


FIG. 3.—DIEHL CEILING FAN WITH 5-LIGHT FIXTURE.

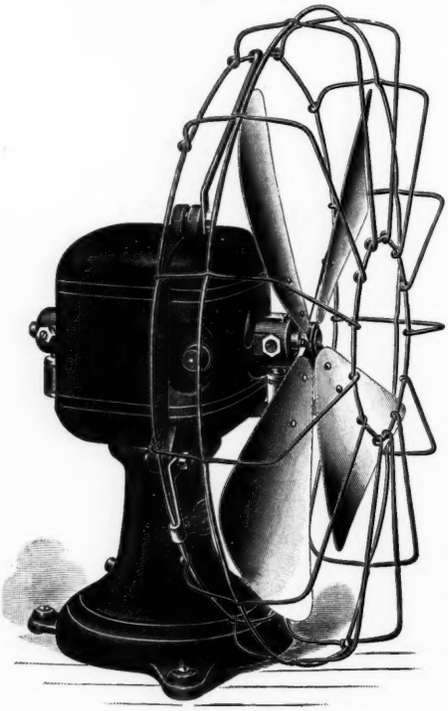


FIG. 1.—DIEHL DESK FAN.

Diehl Electric Fans.

A large and complete line of fans and fan-motors for direct-current circuits is manufactured by the Diehl Manufacturing Company, of Elizabethport, N. J., and a few of the types are illustrated herewith. Fig. 1 represents the type of the 12-inch and 16-inch desk-fan motor with its wire guard. These fans are provided with self-oiling bearings and starting switches, as the illustration well shows. Fig. 2 shows a four-bladed type of ceiling fan, having a starting switch on the lower part easily accessible from the floor. A more elaborate form including with a two-bladed ceiling fan, a fixture for five lights is shown in Fig. 3. The latter is a very popular type of fixture, combining the lights with the ventilating blades so that it may be used in small apartments or crowded situations where separate fans and electroliers would be impossible.

Emerson Alternating-Current Fan Motors.

The electric fan motors of the Emerson Electric Manufacturing Company, St. Louis, are all intended for use on alternating-current circuits. Fig. 1 gives a good general view of the 16-inch desk fan equipped with a peculiar shape of fan blade, which is said entirely to obviate any disagreeable humming noise caused by the swift motion of the blades through the air. The armature of these fans, which are of an induction motor type, is mounted on a hollow sleeve, which runs on a stationary hardened steel one-half

inch shaft. This shaft is tubular, and oil is fed in through it from a cup on the back plate of the motor, and runs out of holes in it to both the front and back bearings of the armature sleeve. It is claimed that it is impossible for oil to escape in any way from the enclosed structure of the shaft and sleeve, though lubrication is very perfect on account of the inside feed. It will be noticed also that, with this construction, dust can not enter the bearing parts. The switch attached to the motor permits its operation at three speeds, the first being a starting position. It is not harmful to operate the motor continuously on the starting point, though there is some saving of current when the intermediate or "on" speed is used. These fans are built in 12, 15 and 16-inch sizes, for 16,000 and 7,200 alternations per minute. On the 12-inch type, for the slower frequency, the current consumption at running speed is stated to be 65 watts, and at slow speed 55 watts.

Fig. 2 shows a bracket fan which differs from the desk fan described above only in the shape of its base, which is a swiveling cast-iron bracket adapted to be screwed to a wall. Fig. 3 illustrates a ceiling fan which carries a four-light incandescent fixture in its base. As it is built on the induction-motor principle, it is naturally extremely simple in mechanical construction and has no brushes, commutator or reducing gear of any kind. The weight of the revolving part is supported on hard steel balls running in oil in a hard steel race-way. It is claimed that with oiling once a season this fan will operate for several years without further attention.

Fig. 3.—Emerson Ceiling Fan with 4-Light Fixture.

The field or primary is the stationary part of the motor, having 28 poles. The coils are form-wound and protected from the laminated poles by hard sheet fibre. The armature is of the squirrel-cage type, the windings being uninsulated flat copper strips with their ends bent over at right angles upon each other and soldered tightly together. The oiling devices attached to this motor are claimed to be of the most satisfactory variety, and are so arranged that the oil in its cup is raised to the top of the shaft whence it is allowed to flow down by gravity. The fan illustrated is equipped with two wooden blades, the entire sweep being 56

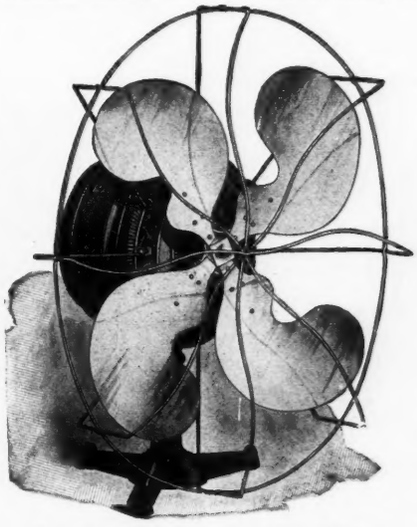


Fig. 1.—Emerson Desk Fan, 16-Inch.

inches, and the whole is carefully balanced to insure the quiet and steady operation of the fan. The speed is about 210 revolutions per minute. On one type of these fans a slow speed is provided and for certain uses left-hand blades, which throw the air upward toward the ceiling, are also furnished. The current consumption at full speed is stated to be 125 watts. Fig. 4 shows a ceiling fan having five blades and adapted for currents of high commercial frequencies and of necessarily a higher speed. It runs from 500 to 600 revolutions per minute, depending upon the frequency of the circuit. Fig. 5 shows a simple form of alternating-current direct-connected exhaust fan, adapted for

Fig. 4.—Emerson High-Frequency Ceiling Fan.

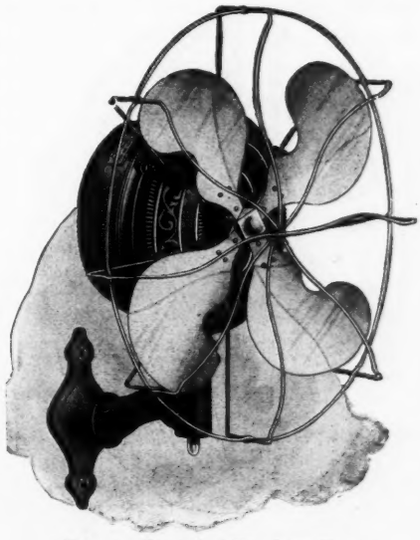


Fig. 2.—Emerson Bracket Fan.

use in kitchens and other places, the illustration showing a type having a 12-inch fan. This fan operates on 125 watts at the standard frequencies and is designed to move 500 cubic feet of air per minute.

Sturtevant Propeller Type Fans.

The exhaust method of ventilation for such enclosures as smoking and dining rooms, restaurants, kitchens, bakeries, laundries, engine rooms, confined spaces aboard ship, hospital wards, etc., has come

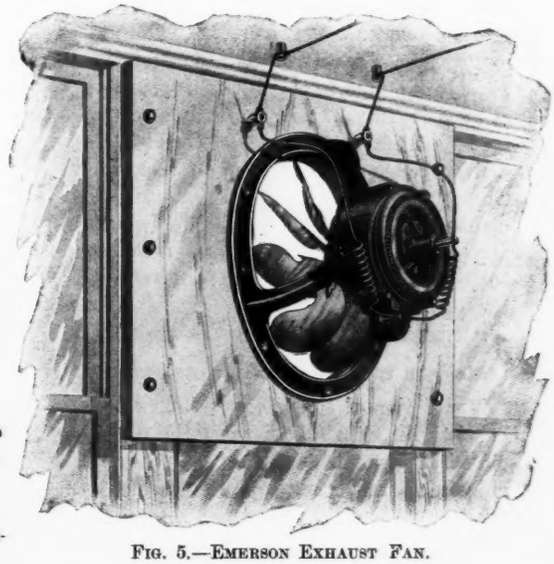


Fig. 5.—Emerson Exhaust Fan.

largely into vogue in recent years. The accompanying illustration shows a very compact form of electric propeller exhaust fan intended to be applied for this purpose, and manufactured by the B. F. Sturtevant Company, Boston, Mass. Fans of this

type are made in sizes ranging from 18 inches to 10 feet in diameter. having capacities of from 2,000 to 175,000 cubic feet of air per minute. The motors are

STURTEVANT DIRECT-COUPLED PROPELLER FAN.

of the bipolar direct-current enclosed type on sizes up to and including 54 inches. In larger sizes four and eight-pole types of motors are employed. The type of motor used is carefully designed to obviate excessive temperatures, and completely enclosed, which protects its working parts from the dust which would otherwise soon seriously affect a machine running under these conditions. The manufacturers claim that their motor will run for 10 hours under full-load with a maximum rise of temperature not greater than 60 degrees Fahrenheit. The design of the propeller wheel has resulted from a long series of experiments. The air is picked up by the inlet edge of the blade at slow velocity and is gradually accelerated until it is delivered by the helical delivery edge at its maximum velocity. The efficiency of this type of fan is claimed to be very high. The whole apparatus is self-contained and adapted to be at once fastened in position to the opening through which air is to be discharged.

Wagner Electric Ventilating Fans.

Ventilation of the positive kind, which consists in actually renewing the air of closed apartments instead of simply stirring it up, has come to be regarded as a sanitary necessity. The types of fan illustrated herewith are of the exhaust variety adapted for such uses, and are made by the Wagner Electric Manufacturing Company, of St. Louis, Mo. Fig. 1 shows a type of exhaust fan adapted to be supported on a shelf, though the flange-supported form, without the supporting base, is the usual and standard type. The motor attached to this fan is of the series type, and so proportioned that 12 different operating speeds may be had by the use of controlling rheostats furnished with it. The consumption of energy, therefore, is closely proportioned to the amount of ventilation necessary, both elements being within the control of the attendant upon the fans. Fig. 2 illustrates a similar variety of ventilating fan, belted to a single-phase, alternating-

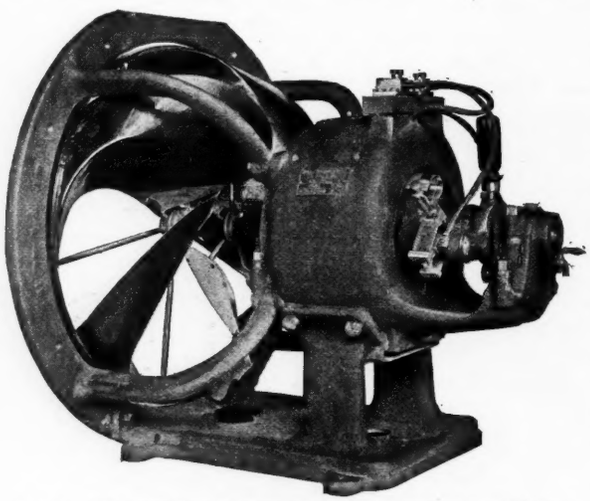


FIG. 1.—WAGNER SHELF-SUPPORTED EXHAUST FAN AND MOTOR.

current induction power-motor. In this type, seeing that the speed of an induction motor is practically constant, speed variations are obtained by cone pulleys placed upon the motor and fan shaft. The standard arrangement, such as is shown in the illustration, has a two-step cone giving full speed and about two-thirds speed, corresponding to full and half-load of the motor. The motors are made for standard frequencies and voltages, and are self-starting and automatic in their operation.

Western Electric Fan Motors.

The construction of the Western Electric Company's new type of desk fan motor is perhaps best understood from the view, Fig. 1, (page 163), which shows the armature in its place, and exhibits most of the features which go to make this one of the best of its class of ventilating machines. It will be noticed that the shaft runs in self-aligning and self-oiling bearings. These are made of Babbitt metal, having their outer surface spherical and fitting in the cylindrical journal so that any trifling lack of alignment or crookedness in the shaft is instantly and automatically compensated. The oil cup marked B in the illustration contains a felt wick and is fastened into the under side of the journal. The gland of this cup steadies the journal while leaving it perfectly free to move in any direction. One filling of the large chambers of the oil cups with heavy cylinder oil will last out an entire season under ordinary conditions. The magnet frame is drop-forged and is held into the base by a slotted bolt marked E. If it is desired to remove the motor from its base this can easily be done by unscrewing this bolt. The armature, as the illustration shows, is of the

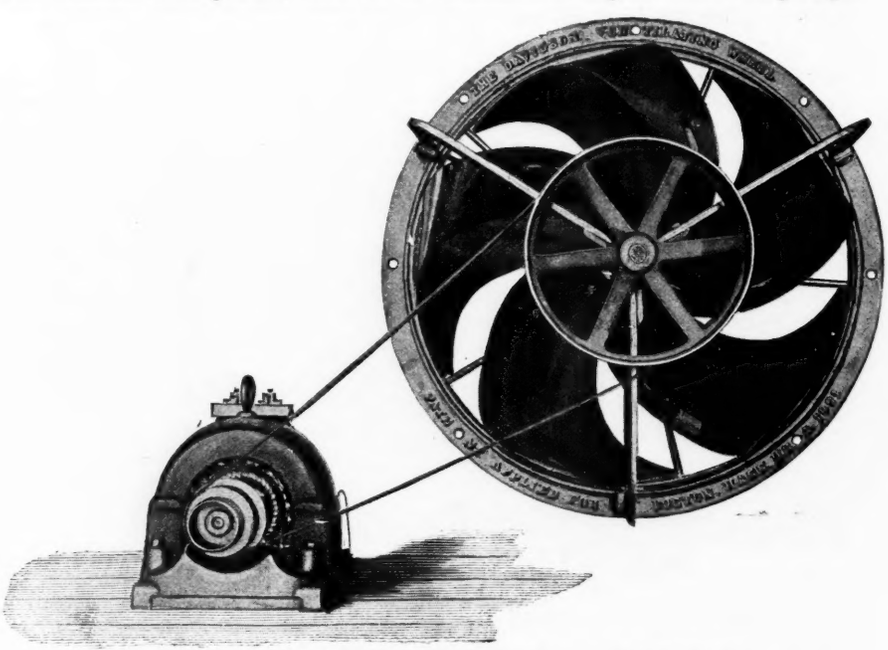


FIG. 2.—WAGNER SINGLE-PHASE INDUCTION MOTOR BELTED TO FAN.

deeply-slotted ironclad type in which the windings lie in tunnels, being fully protected from mechanical injury, the whole being a highly efficient electrical construction as well. The commutator is made of hard-drawn segments insulated by mica, in much the same fashion as the commutators of larger machines are constructed. Since it is always open to view any injurious sparking of the brushes may be corrected before it has done much damage. The brushes used are of a specially prepared graphite and are self-adjusting. By means of the switch D in the base the motor may be operated at three different speeds, resistance being used to cut the speed down for the lower velocities. The rheostat shown at C in the illustration consists of a porcelain spool upon which is wound

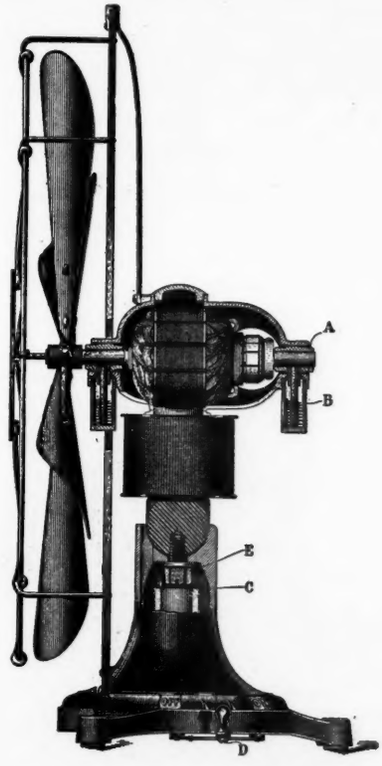


Fig. 1.—Sectional View of Western Electric Desk-Fan Motor.

German silver wire insulated with asbestos and mica. The switches are mounted upon porcelain bases. These motors are made for 110, 220 and 500 volts, the latter being made for direct-connection to the service wires, no series resistance being used in connection with it. The 500-volt motor has an additional precaution in the shape of a double-pole quick-break switch in its base. Fig. 2 gives a good idea of the completed motor. Fig. 3 shows a bracket form for attachment to a wall.

The Western Electric Company, Chicago and New York, which manufactures this type of fan, also makes a large variety of ceiling and other fans for direct-current, fans of various types for battery current, and alternating-current desk, bracket and ceiling fans. The alternating

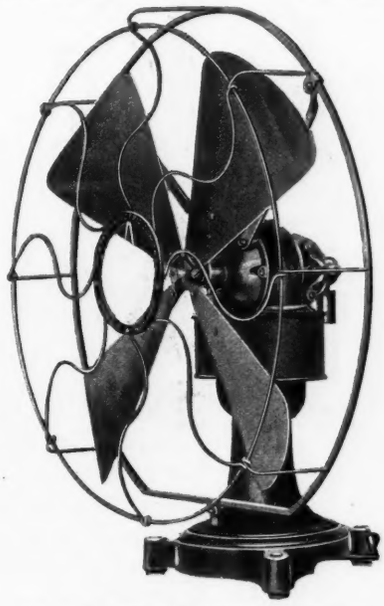


Fig. 2.—Western Electric Desk Fan.

type of ceiling fan consists of an induction motor which drives the fan blades at reduced speed through an ingenious and highly satisfactory friction gearing.

Crocker-Wheeler Electric Fans.

The standard types of fan-motors made by the Crocker-Wheeler Electric Company, of New York city, are well shown in the accompanying illustrations. These motors are of a two-pole type having slot-wound armatures, and generally resembling the power motors made by the same company. Fig. 1 shows the desk type with

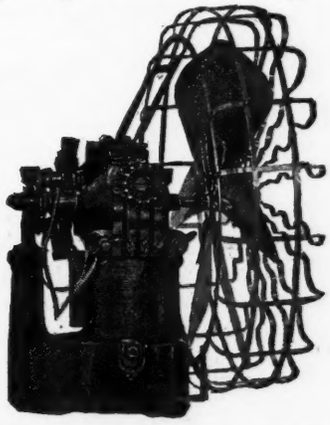


Fig. 1.—Crocker-Wheeler Desk Fan.

six-bladed fan and guard. This machine is made in two sizes, one-twelfth-horse-power having a 12-inch fan, and one-sixth-horse-power equipped with a 16-inch fan. Both sizes are made for 115 and 230-volt circuits, and all have switches, worked by a thumb-knob on one of the pole-pieces, for varying the speed. This variation is accomplished by commutating the windings of the motor and not by the use of idle resistances.

Fig. 2 shows a fan-motor of the same type mounted on a ball-jointed bracket for attachment to a wall. This arrangement is called by its makers "Blow Anywhere," and seems to justify its name, as the direction of the blast of air may be altered

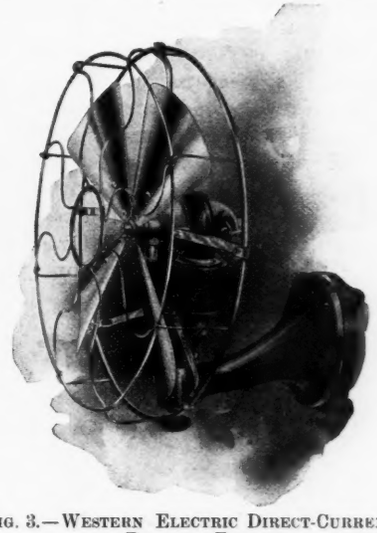


Fig. 3.—Western Electric Direct-Current Bracket Fan.

or set at will. For instance, it may be set at such an angle that the blast of air will be blown against the ceiling, renewing the air of a room without causing a draft.

General Electric Fan Motors for 1900.

The 1900 fan motors of the General Electric Company are distinguished by a number of improvements in mechanical

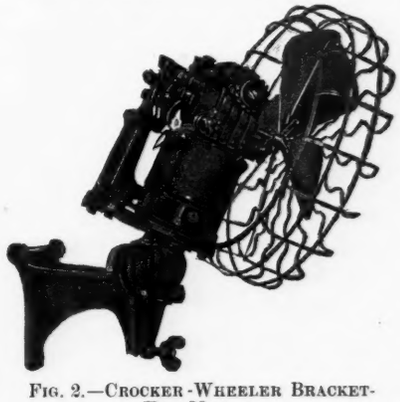


Fig. 2.—Crocker-Wheeler Bracket-Fan Motor.

and electrical design. Among these may be noted the method of lubrication in which the oil cups feed the bearings by means of a wick held against the shaft by a light spring. Any oil escaping from the bearing is collected in a shield and returned to the oil cup. This oil shield also encloses the fan hub, which is grooved to prevent the creeping of oil. The improved oiling device is used on both direct and alternating-current motors.

The four-blade fans with "Monogram" guard are characteristic of this company's motors. The rear guard wire and the supports have been considerably strengthened this year to prevent any distortion of the guard due to careless handling.

The motors are convenient in size and run steadily without noise. With the wall-bracket motors a feature of considerable value are the separate brackets, a number of which may be mounted in various parts of a house, as for instance the dining rooms and sleeping rooms, and only one motor used with the different brackets.

The finish of these motors is black enamel with polished brass fan and fan guard and small trimmings, but, if desired, the motors are finished in colors to match the furnishings of the room in which they are to be used. Royal blue

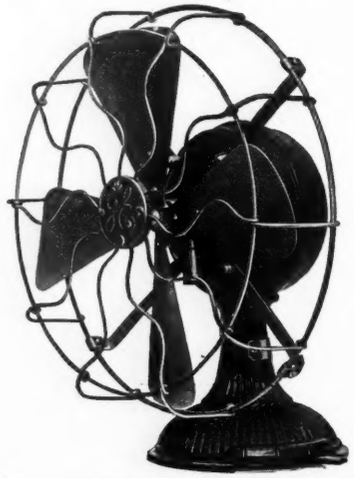


FIG. 1.—GENERAL ELECTRIC SOLID FRAME DIRECT-CURRENT FAN.

and gold, wine red and gold and white and gold are colors in which these motors are frequently supplied.

All the trunnion motors are now provided with a notched clamp which prevents any movement of the motor after the thumb screws are tightened.

The alternating-current desk motors are made with swivel frames and with swivel and trunnion frames. Both of these forms have a three-point regulating switch, which is operated by a projecting key at the back of the motor. The wall motors have regulating switches in the brackets.

These motors are made for 52, 104, 110 and 220-volt circuits. It is worth noting that 110-volt motors may be used on higher voltages up to and including 115 volts. The frequencies on which these motors may be used are 60, 125, 133 and 140 cycles per second.

The direct-current fan motors have a dustproof elliptical body which completely encloses the armature, fields, commutator and brush holders. A light shield covers the back of the motors, and its removal permits the examination of the commutator and brush holders. These

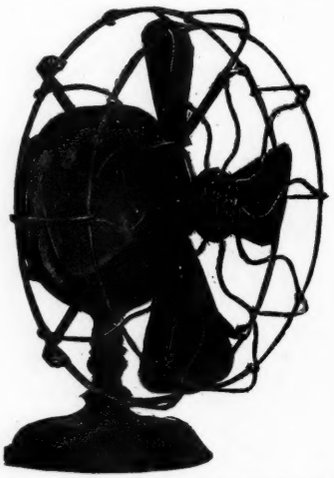


FIG. 2.—GENERAL ELECTRIC SWIVEL-FRAME ALTERNATING DESK MOTOR.

brush holders merit more than passing notice. One notable feature is the use of a rectangular brush, which, when fitted to

FIG. 3.—GENERAL ELECTRIC WALL-BRACKET ALTERNATING-CURRENT FAN.

the commutator surface, wears evenly, and of course can not turn to present a sharp edge to the commutator. The brush holder is practically a miniature of the form used extensively by this com-

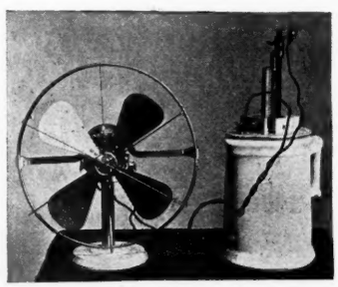


FIG. 1.—"ODDO" FAN AND BATTERY.

pany in large motors and generators, the arms being so hinged that pressure is constant throughout the life of the brush. The motors are provided with three different speeds — the four-point regulating switches being located in the base of the desk motors and in the brackets of the wall motors.

The desk motors are made in three sizes, with 12-inch, 14-inch and 16-inch fans; the 12-inch motors being made with solid and with swivel and trunnion frames. The bracket motors, with 12-inch and 16-inch fans, are provided with trunnion frames and separable wall brackets. The direct-current motors are made for 115 and 220 volts; the 115-volt motors being suitable for any voltage between 105 and 125; the 220-volt motors for any voltage between 210 and 250.

The special bracket motor is designed for use on light partitions which have a tendency to vibrate and act as sounding boards. This motor is supported from its bracket by four springs and runs very quietly. A 10-inch fan is used, only one speed being possible. The snap-switch is located on the wall-plate on the bracket. The attractive design of this motor makes it especially suitable for locations where something more ornamental than the standard motor is desired.

"Oddo" Electric Fan Motors.

Electric ventilation has progressed in two directions since the first fan was

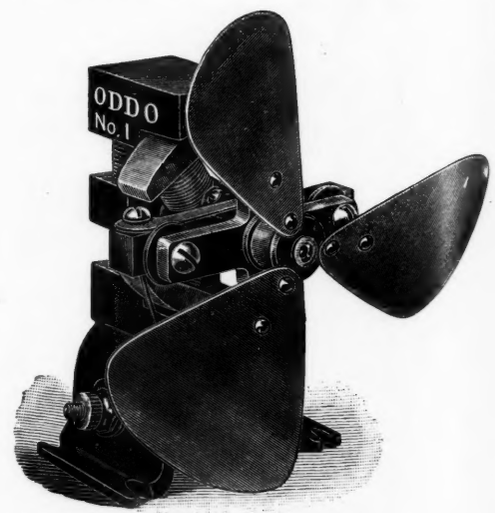


FIG. 2.—THE "ODDO" FAN MOTOR.

whizzed around by an electric motor. One of these has been the construction of gigantic air propellers capable of renewing the atmosphere of a railway station or other enormous building in a few minutes, and the other is the construction of little fans which produce a small and gentle breeze when and where it is most needed. Some simple types of these latter are illustrated on this page, the motors and batteries being thus built by the American Oddity Company, New York city. Fig. 1 shows a complete outfit consisting of an electric fan motor operated by one cell of

battery. Fig. 2 shows the fan motor alone. This motor is of the usual three-pole armature type and is solidly constructed to operate on a battery current. The battery, as the illustration well shows, is made up in a pitcher-shaped jar and is of the bichromate of potash type.

Bates Electric Fans.

Among the various types of alternating and direct-current fan motors, made by D. L. Bates & Bro., Dayton, Ohio, the

FIG. 1.—BATES 16-INCH DESK FAN.

two illustrated are of especial interest. The 16-inch desk fan, for direct current, has a drop-forged bipolar field with which is used an enclosed armature and a four-bladed fan running in a substantial guard. The ceiling fan for direct current is of a four-blade type, and is provided with a single self-oiling bearing, extending the whole length of the armature shaft. This arrangement not only obviates noise in running, but also preserves the alignment of the running parts. Four sockets for incandescent lamps are attached to the bottom of the fans, and the starting switch, at the lowest point of the casing, is protected by a housing.

The manufacturers of these fans also make a large number of other types of

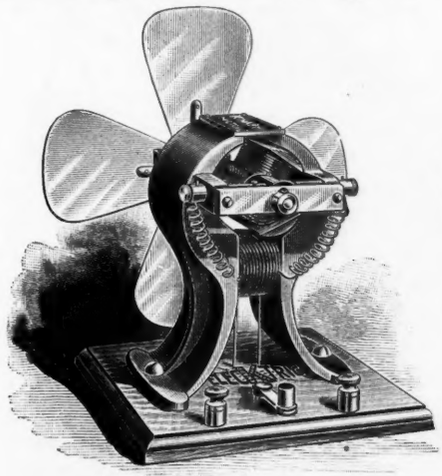


FIG. 1.—KNAPP BATTERY FAN

ceiling, desk, column and electrolier fans, for both direct and alternating-current circuits.

Knapp Electric Fan Motors.

There are many places where electric light current is not available and where it is desired to run small ventilating or cooling

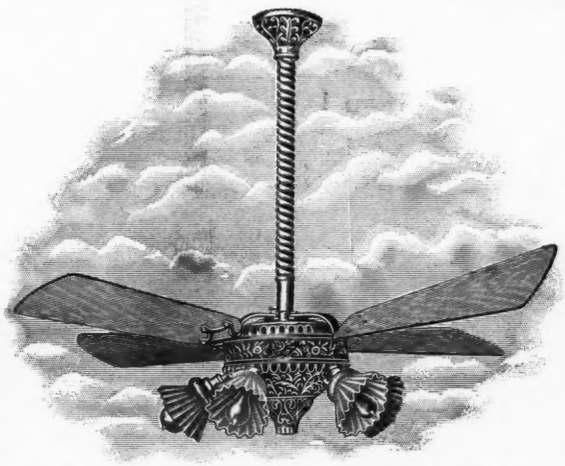


FIG. 2.—BATES FOUR-BLADE ELECTROLIER CEILING FAN.

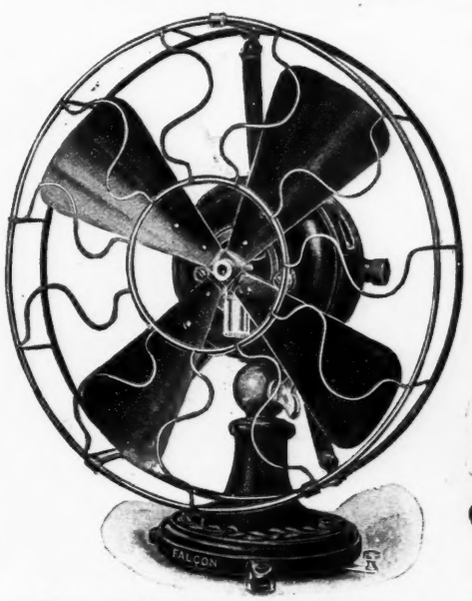


FIG. 1.—FALCON FAN MOTOR OPERATING AS A DESK FAN.

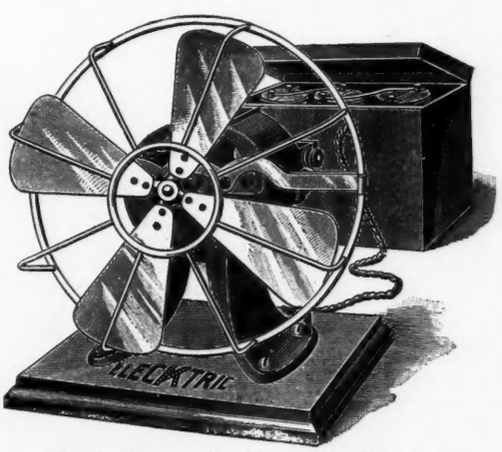


FIG. 2.—KNAPP FAN MOTOR AND BATTERY.

fans from battery power. The illustrations shown on this page represent motors for this purpose, made by the Knapp Electric and Novelty Company, New York. Fig. 1 shows a rear view of a battery fan having a three-pole armature and adjustable brushes. The machine is mounted on a neat mahogany base with a starting switch, and all the brass parts are nickled. Fig. 2 shows a fan motor and battery consisting of three cells and forming a complete outfit for hot weather comfort. Each outfit, the maker states, will run 150 hours without recharging the battery. The cells are of the Gordon type and require no attention during their life. The battery is packed in a neat cabinet with sufficient flexible cord to allow of the motor being placed in a convenient place. In addition to the motors illustrated, the Knapp Company makes a number of toy motors and small motors, also parts of little motors which are intended for boys and others desirous of constructing their own electric motor. Explicit directions for putting the parts together accompany each set of parts.

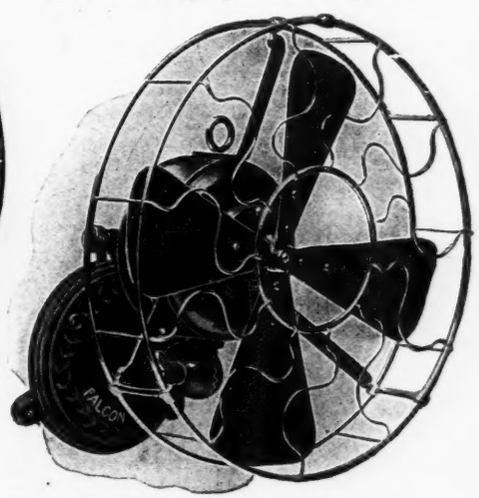


FIG. 2.—FALCON FAN MOTOR OPERATING AS A BRACKET FAN.

Falcon Fan Motors.

A simple and ingenious interchangeable form of fan motor, which is either a desk or bracket type at will, is illustrated in the accompanying engravings. Fig. 1 shows the motor standing upright upon its base and used as a desk fan, while Fig. 2 shows it used as a bracket fan by a simple movement of the universal joint with which it is provided. These motors are made for direct-current of the usual electric light voltages and also for battery currents, in 12 and 16-inch sizes, by the Falcon Electric Manufacturing Company, New York city. In the pedestal of each motor is a resistance and regulating switch giving three speeds. Both armatures and fans are carefully balanced before shipment, thus securing smooth running, and all motors are supplied

with radial-carbon brushes and self-oiling bearings, and it is stated that they will run through a whole season without attention of any kind.

Peerless Fan Motors.

Among the large number of types of electric fans manufactured by the Warren Electric & Specialty Company, Warren, Ohio, is the four-blade electrolier ceiling fan shown in Fig. 1. This fan is adapted for direct currents of 110, 220 and 500 volts, and, with the exception of the last named, all types are constructed for two speeds of operation. They are arranged so that the motor can be removed, leaving the lamps, shades and switch alone, so that in the Winter the fixture can be used simply as an electrolier, and in the Summer its motor and blades replaced and the whole transformed again into a fan and lighting fixture combined.

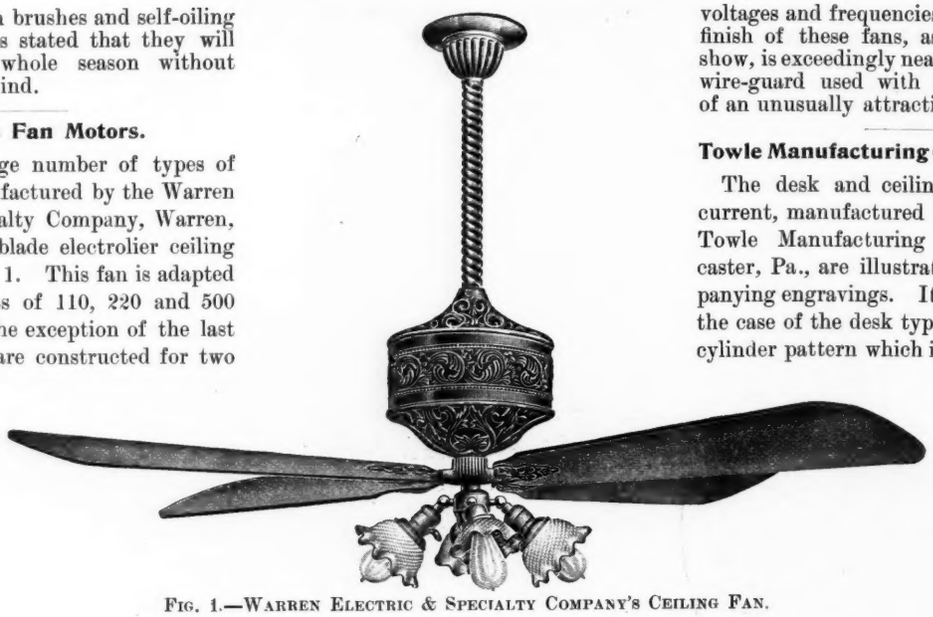


FIG. 1.—WARREN ELECTRIC & SPECIALTY COMPANY'S CEILING FAN.

Fig. 2 illustrates a 12-inch swiveling desk fan, which is tipped over so as to throw the stream of air downwards. This is a four-blade type, controlled by a switch in the base, and having radial carbon brushes and automatic self-feeding oil cups. A substantial wire-guard surrounds the fan.

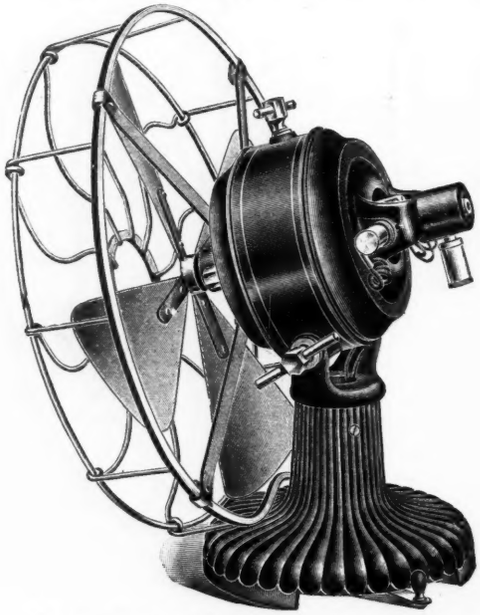


FIG. 2.—WARREN ELECTRIC & SPECIALTY COMPANY'S DESK-FAN MOTOR.

The company makes a bracket fan, having the open type of field coils, with polished brass-end hoods for the armature space and polished brass covering for the field spools. This type of fan is also equipped with the adjustable feature of the design shown in Fig. 2, and, once being in position in any part of the room, it can be turned up or down, or to either side, by the simple adjustment of a small handle.

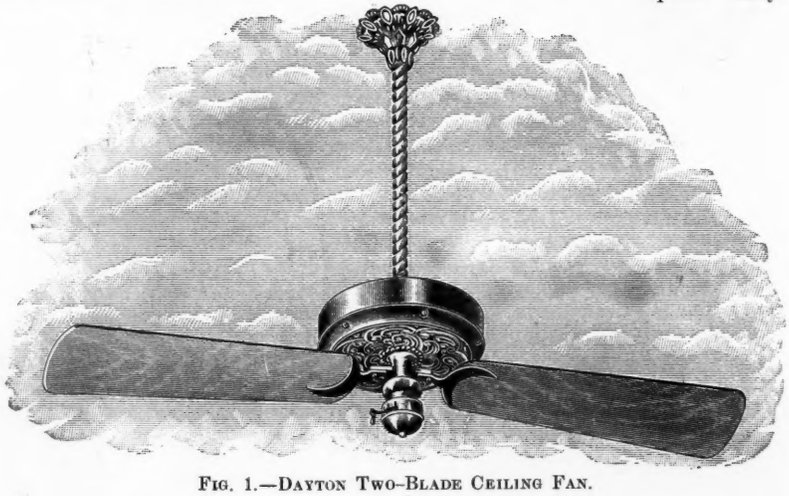


FIG. 1.—DAYTON TWO-BLADE CEILING FAN.

Dayton Fans.

Both alternating and direct-current fans of several types are illustrated in the accompanying engravings. Fig. 1 shows a two-blade ceiling fan, adapted for alternating currents of frequencies between 50 and 65 cycles per second and for the usual voltages supplied on secondary circuits. This apparatus is direct-coupled, and is controlled by the switch well shown at the lowest part of the motor case. Fig. 2 shows a direct-current desk fan which is made in both standard and bracket patterns, the latter adapted for attachment to the wall. This type has a ball and socket adjustment, giving it considerable range of inclination in any direction. The Dayton Fan and Motor Company, of Dayton, Ohio, which makes these fans, also manufactures direct-current ceiling fans in numerous types, including those with attached electric light fixtures for voltages of 110, 170, 220 and 500 volts, and alternating-current desk fans for the usual voltages and frequencies. The mechanical finish of these fans, as the illustrations show, is exceedingly neat and simple. The wire-guard used with the desk fans is of an unusually attractive appearance.

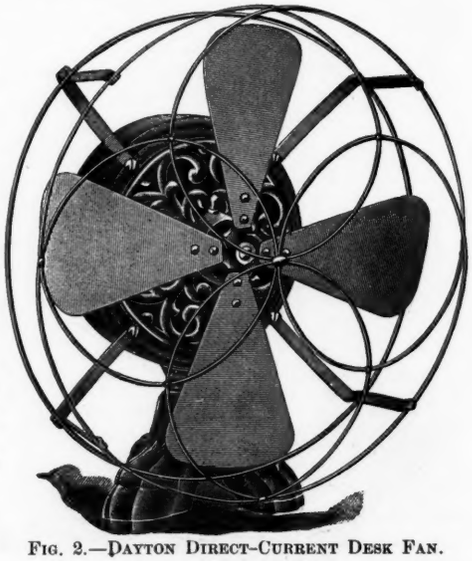


FIG. 2.—DAYTON DIRECT-CURRENT DESK FAN.

Towle Manufacturing Company's Fans.

The desk and ceiling fans for direct-current, manufactured by the George C. Towle Manufacturing Company, Lancaster, Pa., are illustrated in the accompanying engravings. It will be noted that the case of the desk type is of the vertical cylinder pattern which is coming into very considerable favor in fan-motor designs. At the commutator or rear end a large circular ring with a three-arm spider carrying the rear bearing, is attached to the face of the casing, and this construction permits the easy inspection of the commutator, while the opening made when removing the ring is sufficiently

large to allow the removal or replacement of the armature without opening other parts of the motor. The bearings are of bronze, self-oiling and self-aligning, and the brushes are of radial-carbon self-adjusting type. In the base of the motor is a speed regulator giving three rates of speed for the fan.

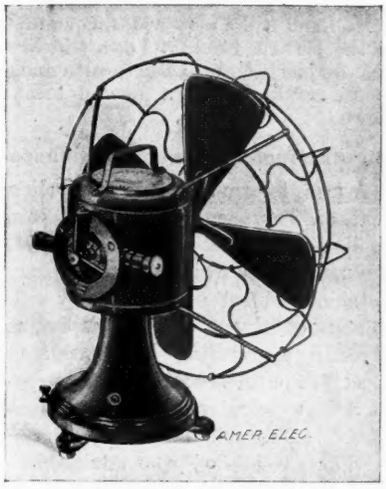
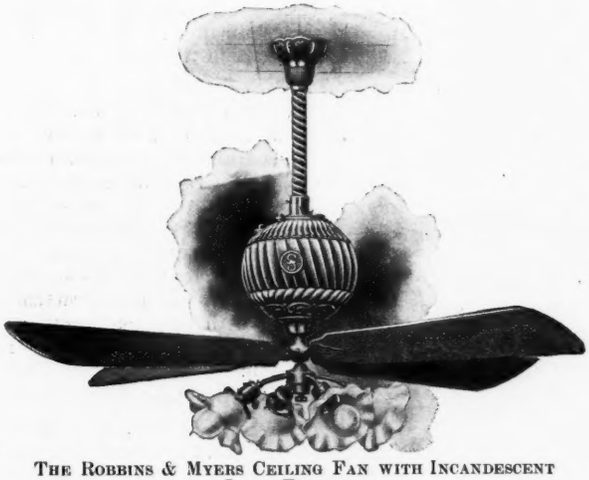


FIG. 1.—TOWLE'S DESK FAN.

The ceiling fan shown in Fig. 2 is of a bipolar type and gives 180 revolutions a minute with the blades at the standard angle of set. By unscrewing the switch-button which controls the fan at the bottom of the brass casing cover, the whole outer case of the machine may be removed, allowing inspection of the commutator and other parts. The main bearing of this ceiling type runs constantly submerged in oil. The four-light electrolier fixture shown in the illustration may be attached to any of the ceiling-type fans with a few simple changes in part of the internal wiring of the motor case.



THE ROBBINS & MYERS CEILING FAN WITH INCANDESCENT LAMP FIXTURE.

Robbins & Myers's Standard Fans.

The Standard fans, made by the Robbins & Myers Company, of Springfield, Ohio, are again offered for their fourth season. Important improvements have been made each year.

The motor is of the enclosed type with a deep-slotted armature, two reentrant poles with projecting horns, and form-wound coils taped and dipped and slipped into place without mechanical fastening. The two bearings are wide apart, large in proportions, swivel type, and composed of anti-friction metal, and run in large semi-enclosed cups full of oil.

The commutator is cylindrical in type—its segments being cut from hard-drawn copper bars, insulated with mica and built on steel sleeves with steel taper collars.

The brush holder is the peculiarly novel feature of the fan. It is called the cartridge brush holder, and consists of a removable brass shell containing a carbon pencil and a piano-wire compression spring.

The yoke and end plates of the magnetic circuit form the case for the motor, being cast in highly ornamental design and heavily plated. The fan may be controlled either by a snap switch on the wall, a wall controller which gives a speed variation over wide range, or by a three-speed switch on the bottom of the fan itself. A feature peculiar to this fan alone is a patented device for allowing fans run in series on 500-volt circuits to be started and stopped independently by a switch on each fan.

The propeller fan, made by the same firm, is called the standard searchlight fan, from its being mounted in a swivel trunnion yoke so that its "beam" of air may be turned in any direction without moving the base of the motor. The motor itself is of the same type as the ceiling fan. The bearings are 1¼ inches long and ⅜ of an inch in diameter. They are lubricated with solid grease, fed by a vibration wire. In the base is concealed a porcelain four-speed switch and resistance. The 1900 pattern is fitted with strong guard of novel and artistic design.

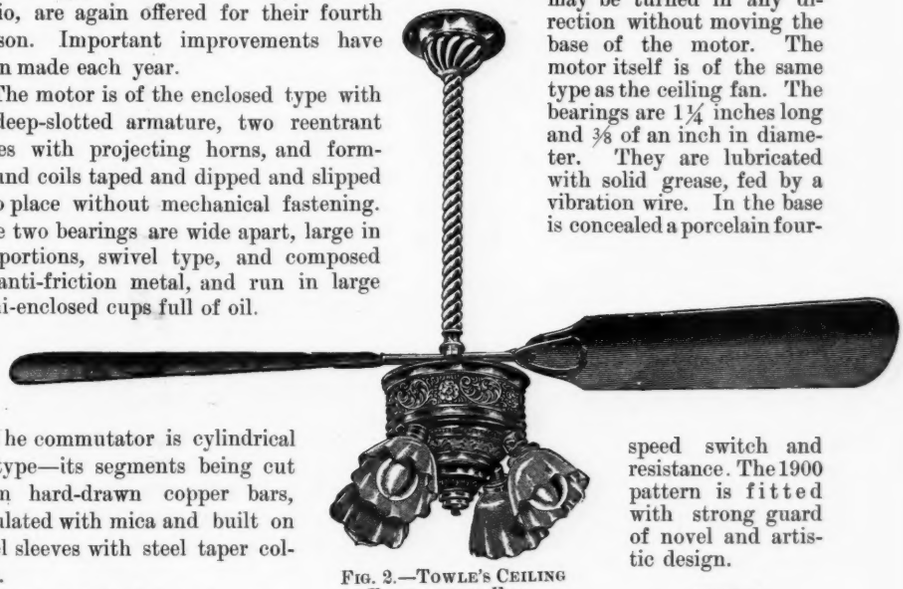
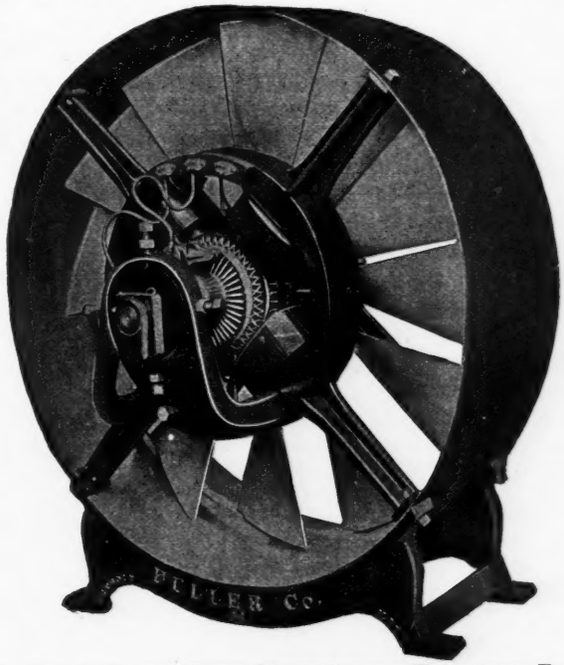


FIG. 2.—TOWLE'S CEILING ELECTROLIER FAN.

Fuller Electric Fans.

The essential points in moving air by a high-speed fan are to handle the greatest volume with the least power expenditure and to avoid noise. It is claimed by the Fuller Company, of Detroit, Mich., makers of the Fuller fans, illustrated herewith, that the minimum of noise and power consumption is attained by the use of the special type of helical fan-blade construction for its motors. The illustration on this page represents a blowing machine and shows a fan direct coupled to a four-pole motor and mounted



FULLER HELICAL BLADE DIRECT-COUPLED VENTILATING FAN.

in its casing. The field ring of the motor forms a part of the spider of the fan-casing, and thus permits of great economy of both space and materials. The support secured in this way is also very rigid. In the motors much care has been given to detail, the coils being of the form-wound pattern, embedded in deep slots in the armature. A rheostat giving five speeds accompanies the motor and has an open-circuit release working automatically from any of the running positions of the fan.

It is claimed that the helical fan operates excellently against a back pressure. Its blades are formed in dies, insuring uniformity, and the retaining ring riveted to the periphery secures steadiness of running and freedom from vibrations, likely to result in getting the fan out of balance.

[The large number of new fan-motor types forbids the adequate mention of all in one issue. The illustrated descriptions will be concluded next week.—ED.]

Berlin Iron Bridge Company's Officers.

The Berlin Iron Bridge Company, of East Berlin, Ct., has elected the following officers for the ensuing year: Chas. M. Jarvis, president; Geo. H. Sage, secretary and superintendent; F. L. Wilcox, treasurer; D. E. Bradley, manager contracting department; James H. Edwards, chief engineer; E. W. Stearns, purchasing agent, and S. N. Robinson, manager New York office.

Settlement of the Phœnix Battery Manufacturing Company's Affairs.

Mr. J. A. Gilliam, assignee of the Phœnix Battery Manufacturing Company, of St. Louis, has opened sealed bids for merchandise, tools, patents and other property of the Phœnix Company, exclusive of its real estate and rights in the Anderson patents. The bid of A. N. Barron, of Cleveland, Ohio, was accepted by the assignee, and on February 9, the sale was approved by the local court.

A Large Wire Order for Manila.

The John A. Roebling's Sons Company, Trenton, N. J., recently completed a large order for the United States Government, amounting to 2,200 miles of galvanized Norway iron wire, numbers 9 and 14 gauge, and weighing 440,000 pounds. This order was entered, started, inspected and shipped inside of 10 days, every coil being accepted on rigid examination by the United States inspectors. The shipment was directed to the chief signal officer at Manila and went on the Java, sailing February 5.

Wall Street and the Electrical Stock Market.

As compared with the closing prices of a week ago, the stock list closed to-day in an irregular manner. People having a live interest in the market were disposed to defer operations owing to the suspension of business until next Tuesday morning.

On the New York Stock Exchange, General Electric closed the week at 125½ bid and 127 asked, a loss of 1 point for the week. Metropolitan Street Railway, of New York, closed at 177½ bid and 178 asked, a gain of 6 points for the week. Third Avenue Railroad, of New York, closed at 100 bid and 100¼ asked, a gain of ¾ of a point for the week. Brooklyn Rapid Transit closed at 73 bid and 73¼ asked, a loss of 2⅛ points for the week. Manhattan Railway, of New York, closed at 97 bid and 97¼ asked, a gain of 1 point for the week.

On the Boston exchange, American Bell Telephone closed at 338 bid and 340 asked, a loss of 7 points for the week. Erie Telephone closed at 107½ bid and no asked price, showing a gain of 3½ points in the bid price for the week.

On the Philadelphia exchange, Electric Storage Battery closed at 78 bid and 80 asked, a loss of 3 points in the bid price for the week. Union Traction closed at 39 bid and 39¼ asked, indicating no change for the week. Electric Company of America closed at 13⅜ bid and 13½ asked, a gain of 1¼ points for the week.

On the curb or outside market in New York, Electric Vehicle closed at 48 bid and 52 asked, a gain of 4 points for the week. Electric Boat closed at 16 bid and 19 asked, a loss of 1 point for the week. Electric Axle closed at 3¾ bid and 4¼ asked, a loss of ¼ point for the week.

Wall Street, February 10.

Edison-Johnson Electrical Company.

A press special from Albany says that the Edison-Johnson Electrical Manufacturing Company, of New York city, was incorporated on February 10, to manufacture electrical machinery and apparatus of all kinds. The capital is $75,000, and among the directors are Thomas A. Edison, Jr., E. G. Johnson and George H. Cook, of New York city.

New York Electrical Society.

The 203d meeting of the New York Electrical Society will be held at the College of the City of New York, Twenty-third street and Lexington avenue, on March 2, at 8 P. M. A. R. Ledoux, M. S., Ph. D., will lecture on "Copper from the Ore to the Bar."

OBITUARY.

Colonel George L. Beetle, of the Western Electric Company, Chicago, died Wednesday evening, February 7. Colonel Beetle was 68 years old and was a very widely known electrical man, and very active in the early development of the telephone, entering that field from the telegraph industry. He had been a very extensive traveler in this country and abroad and had a very wide acquaintance in the electrical field. For a year or two past he has been in failing health and his death resulted from a general breaking down.

Big Automobile Plant in Indianapolis.

A press telegram from Indianapolis says that, on February 10, local and eastern capitalists completed the details of an arrangement by which the second largest automobile plant in the country will be established in that city, the capital to be invested aggregating $2,000,000. The local men at the head of the enterprise are L. S. Dow, secretary and general manager of the Indianapolis Bicycle Company, and Arthur C. Newby, who established the Indianapolis Chain and Stamping Company. Both of these plants were absorbed by the bicycle combination, and the men who managed them have induced the company to enter the automobile business.

BUSINESS NOTES.

The Manhattan General Construction Company, of Newark, N. J., and 11 Broadway, New York, reports a large and increasing sale of its Manhattan series alternating-current enclosed arc lamps. These lamps when working under 6.6 amperes, about 72 volts, or 430 watts, showing thus an efficiency of 99 per cent and a power-factor of 91 per cent. Only five watts are lost in the lamp.

Mr. J. S. Speer, general manager of the Speer Carbon Company, St. Marys, Pa., has been in New York during the past week in connection with certain large sales of carbons. It is understood that this company is in a very prosperous condition and that Mr. Speer has met with unusual success during his present New York visit. The Speer Carbon Company, Mr. Speer mentions, is now practically fully equipped with new machinery, and the recently constructed factory is well under operation.

Schiff, Jordan & Company, 232–234 Greenwich street, New York city, are the distributors for this country of the high-grade imported "ship" carbons for electric lighting. They request that mention be made of the fact that they are pleased to send samples to prospective purchasers. This company also deals in electrical supplies in New York city, and carry in stock a full supply for facilitating prompt shipments. They have just received from the press a small catalogue illustrating and describing the specialties that they manufacture, which will be mailed on application.

TELEPHONE AND TELEGRAPH

The Delmarvia Telephone Company, of Wilmington, Del., has begun extending its lines to Elsmere, Newark and Newport and Elkton and Perryville, Md.

The Western Union Telegraph Company refuses to pay the franchise tax levied by the Missouri State Board of Equalization on the ground of illegality. The case will be taken to the Supreme Court.

The Telephone, Telegraph and Cable Company of America, in which members of the Whitney syndicate are interested, having purchased the Mount Vernon, N. Y., Telephone and Messenger Company, is about to rebuild the entire plant.

The directors of the Michigan Telephone Company have called a meeting of the stockholders at Detroit, Mich., for the purpose of passing upon the proposed increase in the company's capital stock of $7,500,000, making total capital $10,000,000.

A representative of the Southwestern Telephone Company has made the citizens of Bonham, Texas, a proposition to build a telephone line to several points on Red River, including Ravenna, Mulberry, Tulip, Ragsdale and other points. The proposition has met with much favor and the line is almost assured.

The Federal Telephone Company, of Pittsburgh, Pa., is negotiating for the purchase of the plants and service of the Home Telephone Company, at Wilkinsburg, Verona, Parnasus and a number of neighboring towns. The deal has not yet been closed. The Federal Company has not purchased the plant at Greensburg, as has been stated.

The Pittsburgh & Allegheny Telephone Company, a branch of the United Telephone and Telegraph Company, which is instituting general competition against the Bell Company, will begin to operate a telephone system in Allegheny County about April 1. Underground wires are being laid. The new company will begin with 5,000 subscribers.

The plans of the recently incorporated Interstate Telephone and Telegraph Company, of which former State-Senator C. W. Kline is president, and Alvan Markle and Charles Mans, of Hazleton, Pa., directors, have been made public. The object of the new company, which is capitalized at $2,000,000, is to establish a long-distance telephone service in Pennsylvania, Delaware, Maryland and New Jersey by connecting all the independent telephone systems of these states.

The Southern New England Telephone Company has elected the following officers and directors: President, Morris F. Tyler; vice-president, James E. English; secretary and treasurer, A. H. Embler. The old directors were elected as follows: Morris F. Tyler, James English, William E. Downes, Lyman B. Jewell, John W. Alling, Thomas Sherwin, John E. Hudson, General S. E. Merwin, Judge A. Heaton Robertson.

The price paid by the Erie Telephone Company for the Central Telephone Company and the Dowagiac Telephone Company, of Kalamazoo, Mich., the purchase of which was recently announced, was par for the stock which had been paid into their companies, $100,000 in the case of the Central Company. The same offer has been made to the Kalamazoo Mutual Telephone Company, and the stockholders will meet and consider it.

The Erie Telephone system has issued a circular in which the following statistics are given: On January 31, 1900, the total number of stations connected was 110,233; waiting connection, 4,861; making a total of 115,094. It is estimated that by December 31, 1900, the company will have over 150,000 stations. The companies included in this estimate of the whole Erie system are: The Southwestern Telephone and Telegraph Company, Northwestern Telephone Exchange Company, Cleveland Telephone Company, Michigan Telephone Company and Wisconsin Telephone Company.

The Southern New England Telephone Company has made its annual report, showing a good statement for the year. The gross receipts for the year ending December 31, 1899, were $689,005; expenses, $525,949, including fixed charges of $35,011. The net earnings were $163,510; dividends were $150,660, leaving a surplus for the year of $12,850. Gross earnings in 1895 were $644,003, and net $210,130, with surplus over dividends of $59,479. The number of stations in the state of Connecticut on December 31, 1899, were 12,697, an increase for the year of 2,108. Public toll stations increased 65 for the year. The company's wires now reach 157 out of the 168 towns in the state. The average rental for 1899 was $40.26 per station, and $45.25 in 1898, a decrease of $4.99. The 2,108 stations added during the year were at an average rental charge of $1.10 per station.

Automobiles have appeared at a number of hunts and shooting meets in England.

ELECTRIC LIGHTING

The Canton, Pa., Electric Light Company will have its new storage battery system in operation about the last of February.

A proposition to bond the city of Muskegon, Mich., for $40,000 to build a municipal electric lighting plant will be submitted to the voters in the Spring.

The works of the Electric Improvement Company, of San Jose, Cal., were destroyed by fire a few days ago. The loss on the building and machinery is estimated at $100,000, and the insurance is $50,000. The works will be rebuilt immediately.

The board of directors of the Consolidated Gas and Electric Light Company, of Batavia, N. Y., met recently and organized by electing the following officers: President, S. D. Purdy, of Warsaw; vice-president, John H. Ward; secretary, R. L. Kinsey; treasurer, John Thomas. All were re-elected except Mr. Ward, who succeeds E. O. McNair, of Warsaw.

The directors of the Hartford, Ct., Electric Light Company have decided to recommend to the stockholders that the capital be increased from $700,000, its present figure, to $1,000,000. The new capital will be used to pay for the new power developed at Farmington River, and a new storage battery at the Pearl street plant, and for other purposes.

Copies of the certificates of merger of Manhattan Lighting Company, North River Electric Light and Power Company, New York Heat, Light and Power Company, Block Lighting and Power Company No. 1, Mount Morris Electric Light Company and Borough of Manhattan Electric Company, all of New York city, with the New York Gas and Electric Light, Heat and Power Company have been filed with the Secretary of State.

At the annual meeting of the stockholders of the Northampton, Mass., Electric Lighting Company, these officers were elected: President, A. McCallum; treasurer, C. E. Gould; directors, the officers and Prof. J. T. Stoddard, S. B. Fuller and C. H. Pierce. The financial report shows increasing business, and a six per cent dividend was recently declared. Improvements have been made at the plant which cost $4,000, these including an alternating machine with a capacity of 2,500 lights and a 100-horsepower generator.

BRITISH NOTES.

(From our special Correspondent.)

The war, as usual, is the engrossing topic, but electrical circles are becoming seriously exercised over the repeated failures of electric light, to which, I think, I made some allusion in my last letter. The City of London Electric Lighting Company has always been one of the worst offenders, and like all offenders of this class, particularly smart at seizing upon any passing excuse to palliate its shortcomings. It has also taken the wise precaution of "toadying" a considerable section of the electrical press, and the way that that section of the press (with a very few honorable exceptions) rose to the bait is by no means creditable. However, their patience is getting exhausted at length, and last week the *Electrical Review* (London) spoke its mind very plainly on the subject and showed, in a leading article, that the City of London Company was doing badly under all circumstances; that even if the current excuse of lack of coal, owing to the demands of Government for the war, held good, this did not in any degree explain the extraordinary inequality of the pressure maintained, which they had tested by a recording voltmeter fixed up on the premises. This, the *Review* maintained, could be only due to bad management and ineffective supervision, and they consider that it is quite time that the matter was carefully looked into, and in this view most people will agree with them.

To my mind, however, the evil lies lower still. I have, before, written to you of the unpleasant position occupied by the average municipal engineer in having to put up with the terms accorded to him by the under-bred boors who form the bulk of our municipal bodies. He has, not unnaturally, tried to regain the balance of his self-respect by other methods. The municipal engineers, and I must include among them the large central station engineers, have their own little organ in the press, which is maintained by the advertisements of various kinds, of which they have the disposal, and in this they pay each other pretty compliments, and record each other's doings with a friendly familiarity which is very charming but rather misleading. If the borough of Little Pedlington requires an assistant engineer or subordinate of any kind, this excellent organ writes that Mr. Robinson-Snooks, the borough electrical engineer of this well-known centre of civilization, requires an assistant, and all other announcements are worded in a similar way—that is to say, it is always made to appear that it is the borough electrical engineer and not his masters who require the services of this subordinate. So, in like manner, with everything else that goes on. It is always Mr. Robinson-Snooks and not his masters; indeed, to read the pages of their organ, you would hardly believe that his masters existed, let alone that they dared to insult him with the greatest regularity whenever they meet. Now, of course, when a mutual admiration society is strong enough to run its own organ, and impose the praises of its members upon the profession by dint of their command over the sources of advertisements, it is not difficult to predict that the next step will be that the members of that society begin to suffer from what I believe they term on your side of the Atlantic, "swelled-head." That is precisely what has happened. The municipal and central station engineer reads his paper to his friends, brushes his hair well up into tufts in front, and affects the hyphened or otherwise fancy surname, and consoles himself for his bad times with his masters by figuring as a very great man before the public. Equally naturally, his attention is distracted from the humdrum duties of the office by consideration of his own importance, and last of all his supervision becomes irregular and his work suffers. That is one of the causes of the mischief.

Another contributory cause is that this organ, of which I have spoken, publishes every week tables of costs for the various lighting stations. These are compiled by one of the greatest authorities on the subject, an old hand who is entitled to the very greatest respect, and who has certainly achieved a considerable reduction in the expenses of electric lighting by the policy which he initiated when he first started this organ, and when the electrical profession was not quite so overrun with children-in-arms as it is now. But I venture to think that this has done its work; the new generation of central station and municipal engineers think now of very little besides keeping their costs down; and the natural result is that this is done very frequently at the expense of efficiency; he thinks, in fact, more of self-advertisement than anything else. Now, it is a curious fact, of which you are probably aware, that the man who advertises himself the least is very often the best man. In the country town where I reside electric light is cheap and steady, but we have the advantage of being run by a man whose name is seldom mentioned in the columns of the contemporary to which I have alluded, or anywhere else—that is to say, his first idea is to devote himself to the duties of his office. If we had a few more such men and considerably less of the Robinson-Snooks fraternity we should do a great deal better.

I have been driven to write thus strongly because matters over here are really getting serious. Between municipalization and the new type of central station engineer, which I have described, electric lighting in this country has received a very serious check indeed. It is nonsense to ascribe everything to the want of coal. That excuse applies to many other things in which there has been no such deterioration as there has been in electric light. Gas, for instance, is directly dependent upon coal, but gas is not perceptibly worse than usual, though, to be sure, that is hardly possible. But what is happening is that more than one town is now reverting to gas for street lighting and in houses, and that unless something is very speedily done a great many more will follow suit, and electric lighting will be thrown out for a generation. That is the danger, and I wish that it could be more widely realized.

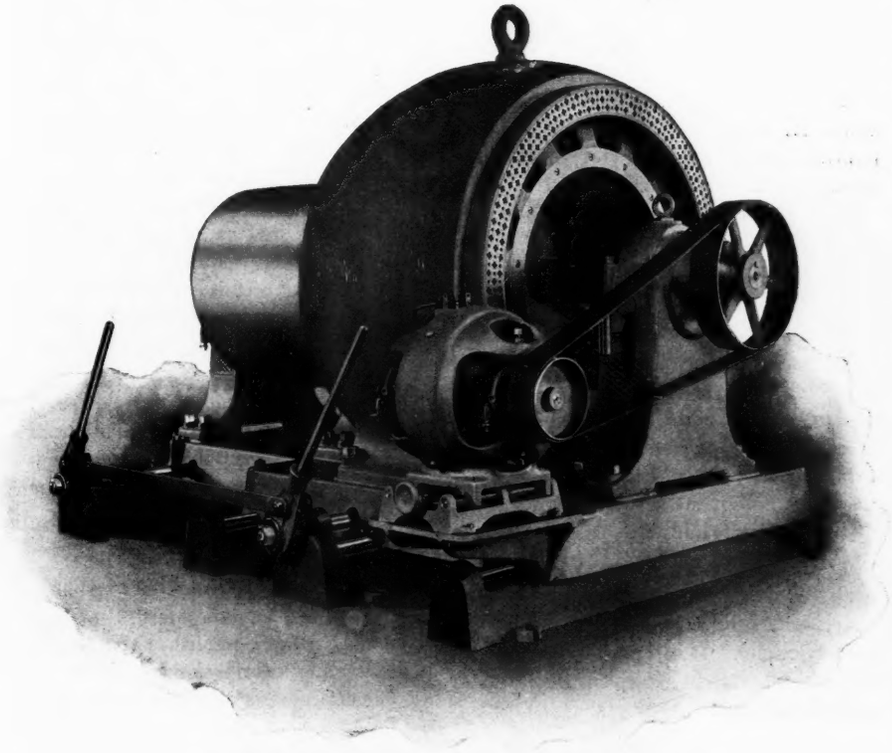
You will be astonished to hear that an electrically-drawn train has really been seen operating upon our Metropolitan and District Railway, on the short section between Earl's Court and High street, Kensington. The great "experiment" to determine for ourselves what the outside world have already determined on their own account, has so far borne fruit that it is demonstrated to an astonished English public that electricity can really be utilized as a tractive power. Of course, the daily papers are saying, exultingly, that steam will soon be abolished on the Underground Railway, and that during the coming Summer we shall be able to travel by that unspeakable route in comfort. But, between ourselves, I do not believe it. The Underground Railway authorities have humbugged the public for so long that it will be quite time enough to believe in electric traction upon their system when we see it actually at work.

Electrical engineers have, however, not been backward to take their share in the burden of the war. Major Crompton, the well-known electrician, has offered his own services and those of 50 highly trained subordinates to the War Office for service in South Africa, with searchlights and other electrical apparatus, and that offer has been accepted. The War Office has allowed £3,000 for apparatus, but it is likely that this amount will be largely supplemented by subscription among members of the profession. For it is intended that this body of men shall be equipped in the very best style. We shall look forward to their doings in the field with interest.

London, January 27.

A Handsome Inductor Alternator.

The illustration shows an inductor alternator of 250 kilowatts capacity recently installed in the Manor, Pa., plant of the Irwin Electric Light and Power Company. The machine is built on the well-known principle involving the use of stationary coils, both for inducing magnetism in the moving part and for generating the currents delivered, and the machine has upon it no moving wire of any sort. The rotating part, which is built of steel castings and laminae, weighs about 6,000 pounds and runs at a speed of 572 revolutions per minute. The dynamo, at this speed, delivers 2,200 volts at its terminals, single-phase, at a periodicity of 133 cycles per second. The machine is used for operating both arc and incandescent lamps, and also drives a synchronous motor of 125 horse-power which is situated in a coal mine and used to furnish power for a direct-current generator; this in turn feeds a large number of coal cutters as well as lighting the underground workings of the mine. The machine is claimed by its manufacturers to give a commercial efficiency of between 94 and 95 per cent. On account of the inductor design it has, of course, neither sliding contacts, commutator or collector rings, the current being taken directly from binding posts attached to the fixed armature. The exciter is bolted, as the illustration well shows, to a bracket on the base of the large machine. This handsome dynamo was constructed by the Warren Electric Manufacturing Company, of Sandusky, Ohio, which was among the first to make dynamos of this type in the United States.



A 250-Kilowatt Inductor Alternator with its Exciter.

Brooklyn Rapid Transit Company.

The Board of Directors elected at the recent annual meeting of the Brooklyn Rapid Transit Company met for organization at the office of A. N. Brady, in New York city last week. The following officers were reelected: Chairman of the board, A. N. Brady; president, Clinton L. Rossiter; vice-president, H. C. Duval; secretary and treasurer, T. S. Williams; assistant secretary and treasurer, C. D. Meneely. The following directors were chosen members of the executive committee, with the chairman of the board and the president members ex-officio: A. R. Flower, E. H. Harriman, Walter G. Oakman, H. H. Porter, Henry Siebert. Messrs. Harriman, Oakman and Porter represent the new interests that entered the board of directors at the annual meeting.

National Electric Light Association.

The headquarters of the National Electric Light Association for the twenty-third annual convention, which will be held at Chicago, on May 22, 23 and 24, 1900, will be at the Auditorium Hotel. Special rates on both the European and American plans have been secured.

Electric Lighting in Dublin.

Writing from Dublin, Ireland, under date of January 8, 1900, United States Consul Joshua Wilbour says: A scheme for extending the electric lighting system of the city of Dublin has just received the approval of the Municipal Council of the city. Application has been made to the local government board to hold sworn inquiries as to the necessity of the work and the desirability of carrying it out. If the local government board approves of the scheme, as it undoubtedly will, it will empower the corporation of the city of Dublin to apply for a loan of $1,272,000 to carry out the extension. As soon as the loan is raised, the specifications will be prepared and the various contracts advertised. It is thought that the corporation will be in a position to receive tenders by March 1 next.

The estimated capital expenditure is as follows:

Feeding and distribution	$515,000
Public arc lighting	202,000
Works at pigeon house	480,000
Meters and house connections	75,000
Total	$1,272,000

This sum includes the estimated cost of the whole plant, together with the work of laying mains, trenching, etc. The following are the estimates for some of the more important details:

For buildings, foundations for plant, chimney, etc.	$100,000
Engine-house plant	179,500
Boiler-house plant	58,350
Pipe and feed tank	17,500
500 lamp-posts, etc.	55,000

The plan, briefly, is as follows:

The supply works are to be erected at the pigeon house, which is at the entrance of the harbor. The current is to be delivered to the distributing centre at Fleet street through three trunk mains sufficient to supply 100,000 8-candle-power lamps, all alight at one time.

In conclusion, I may say that I know of no reason why a large proportion of this work should not be secured by our manufacturers, as in Dublin there is already a large power station for the tram company in which American machinery has been installed, which has given satisfaction.

Mr. Whipple, Electrical Inventor, Wanted.

To the Editor of Electrical Review:

I should feel very much obliged if you would furnish me with the address of Mr. Whipple, an American, the inventor and patentee of an electrical contrivance for determining the temperature of steam in boilers. If that gentleman would communicate with the undersigned, he may hear of something to his advantage.

Stuart Stanley.

Hendaye, France, January 21.

VIEWS, NEWS AND INTERVIEWS

The New York City Rapid Transit Commissioners have given John B. McDonald until February 20 to furnish the $6,000,000 bonds required under the contract. Mr. August Belmont is forming a construction company and is making considerable progress.

Comptroller Coler, of New York city, announced on February 6 that he intended to impose the full penalty allowed by law on street railway corporations which had not paid their car-license fees or percentages of fees promptly. A bill has been sent to the Metropolitan Street Railway Company calling on them to pay $28,646.65 in penalties. The $150,000 which the Broadway Surface Railroad pays annually to the city has been due three months and six days. Fifteen other roads operated by the Metropolitan Company are one month and 29 days behind. The penalty for tardy payment is five per cent a month. The total due to the city for percentages and fees is $197,218.45, making the total bill which the city has against the Metropolitan, $225,865.10.

It is recorded in the foreign press that owing to an explosion in the Municipal Gas Works, at Weiner Neustadt (Austria), that town, which is only an hour's distance from Vienna, and contains 25,000 inhabitants, will have to remain without gas for weeks. The theatre has already been closed.

The telephone line of Moosehead Lake is to be extended to the Northeast carry this Summer. Next Fall a Boston business man can wait until his guide tells him that he has a moose located all ready for him, then take a train, shoot the moose and be back in Boston, modestly triumphant, in three days from the time of starting.

The entire electric plant of the Bellaire Steel Company, near Wheeling, W. Va., has been destroyed by fire. The destruction of the plant has been instrumental in throwing 700 men out of employment.

At Hartford, Ct., lately there was a drought, and the engine in the river pumphouse took the opportunity thus presented to break down. The Hartford Street Railway Company immediately loaned the city a 300-horse-power motor, connected it with its railway lines, and set it to work to drive the pumps. Ever since its installation the company has been supplying current to operate it without cost to the city. This kindly act of the "soulless corporation" has certainly not diminished its popularity in its own town.

The municipal electric lighting plant has certain peculiar privileges. At Wallingford, Ct., one was recently installed. A local paper says: "The blowing of the siren at the electric light plant about 8:30 Sunday evening brought about half of the residents of the borough out in the rain looking for a fire, supposing it was sounded for a fire alarm. Other factory whistles were blown and the fire-bell in the town hall rung. There was no fire and the siren was to call the linemen to fix an arc light that had fallen down on South Main street." Imagine a private lighting corporation using the village fire-alarm to summons its employees!

An electric light company is about to commence operations at Cape Nome. If there was ever a terrestrial paradise for a concern of that kind, says a Pacific Coast newspaper, it is in the Arctic Circle, for with continuous service during the six months' night of the Winter and the opportunity to close down entirely in the Summer, there will be no deadweight expenses to offset the big income in sight.

A press telegram from Menominee, Mich., says that the Ann Arbor Road has closed a contract to use Marconi wireless telegraphy. It will place instruments at Frankfort, Mich., Sturgeon Bay, Wis., and Menominee.

The steamship Dominic arrived in New York city last week from Manaos and Para with a cargo of crude rubber. In this cargo are two immense pieces of rubber of spherical shape, known as "biscuits," each weighing between 800 and 900 pounds. They are among the largest specimens of the crude article ever brought to New York and will be sent to the Pan-American Exhibition, at Buffalo. The average "biscuit" weighs from 30 to 75 pounds, sometimes as much as 200 pounds.

A New South African Cable.

A submarine cable from Cape Town has been laid to St. Helena, and the cable was landed on November 23, 1899. The present tariff is $1.70 per word, but on the final completion of the line, the rate will be 97 cents to England.

AUTOMOBILES

Mr. James T. Allen, examiner, United States Patent Office, has been compiling a volume dealing with all patents on carriages propelled by electricity, gas, steam, or other power between 1789 and July 1, 1899. It will contain photographic reproductions of all the drawings, with text dealing with the matter of the essentials, of the specifications, the claims in full, and other matter.

The Italian general staff has ordered the construction of a few automobile caissons for field artillery, which will be made to demonstrate their practicability this Spring, says the *Scientific American*. The War Office will make public the results of their experiments during the Exposition. Three models for ordinary field service will be shown. First is a strongly built vehicle of high power and of the racing pattern, provided with a motor which will produce a speed of 40 miles an hour. It is intended for the carrying of dispatches. The second will be a heavyweight traction car for carrying large field pieces. There will also be a very light petroleum motor tricycle armed with a maxim gun. Motor ambulances, wagons for the use of the field telegraph service and motor cars for the use of the staff will also be exhibited.

A Country Editor's Idea of It.

Our esteemed contemporary, the Rock Island, Ill., *Union*, publishes the following interesting information:

"The cornplanter which is installing a new lighting plant, which is to be an up-to-date affair of about 50 300-candle power lights. It will be used exclusively in the shops and is of the latest pattern, being what is known as the incandescent arc light system. The lamps are of the same shape as the regular arc lights, but are entirely different in the system and in the quality of the light furnished. Instead of burning two carboons the lamps have but one. This is encased in an air-tight transparent china globe, and when the power is turned on the carboon becomes red hot, like the delicate incandescent light wires. The lamps do not require any more attention than the incandescent either, as the carboons have to be renewed only about once a month. They never have to be cleaned and the light furnished is a steady glow. The new plant will be ready for use about the first of February. The company will generate its own electricity."

ELECTRIC RAILWAYS

The Bethlehem, Pa., & Nazareth Passenger Railway and the Bethlehem Electric Company have been leased to the Allentown Electric Light and Power Company for 999 years.

The Negaunee & Ishpeming, Mich., Street Railway and Electric Lighting Company has declared a dividend of four per cent on its capital stock. This is the first dividend in the history of the company.

The power house and the car station of the Lexington & Boston Street Railway, at North Lexington, Mass., are practically completed. The officials of the road say the first car will be run and the road opened April 10.

A corporation has purchased the street railway lines of Aurora, Ill., and the scheme now is to organize a company and take in all the lines of the suburbs and unite them. From the smaller cities the lines will run directly to Chicago.

The New Paltz & Poughkeepsie, N. Y., Traction Company took formal possession of its electric railroad on January 20. The road will continue under the management of C. C. Southard, general manager, and E. E. Hawkins, superintendent.

A deed of trust for $500,000 was recently given by the Fries Manufacturing and Power Company and the Winston-Salem Railway and Electric Company, of Winston, N. C., to the North American Trust Co., of New York, for new cars and machinery.

The Pottsville, Pa., Union Traction Company has given orders for the construction of two more branches. One will be three miles in length, tapping the Heckshersville Valley, and the other will run from Pottsville to Middleport, a distance of six miles.

The Dunkirk & Fredonia, N. Y., Street Car Company will demand $10,000 damages from Fredonia Village on account of cars burned in the recent fire. The company claims it could have removed its cars from the barn had not the fire chief refused to move the hose from across the rails.

Negotiations have been opened between the owners of the Skowhegan, Me., & Norridgewock Electric Road and William H. Perry, of Boston, and George B. Boutwell, of Providence, for the purchase of the road. The plan is for the new owners to make several extensions of the road by which the hauling of several large manufacturing concerns may be done by the road.

The Decatur, Ill., Traction Company, has issued $250,000 in 20-year five per cent bonds, payable semi-annually in gold, and has given a mortgage for that amount to the Union Trust Company, of Cincinnati, as trustee. It is the intention to expend $125,000 of this issue in improvements on the property.

The Chicago General Railway Company, which has adopted the two and four-cent fare schedule, is said to have increased the number of its patrons by 234 per cent. The two-cent fares are restricted to certain districts, while the four-cent ticket is good on all lines for a ride of less than six and one-half miles.

At the annual meeting of the stockholders of the Allentown & Kutztown, Pa., Traction Company, these directors were chosen: G. H. Gerber, C. A. Dorney, W. D. Mohn, Asa R. Beers, H. E. Ahrens and H. J. Schmick. The former officers were re-elected, Mr. Gerber as president; Mr. Beers as secretary, and Mr. Dorney as treasurer.

The rapid transit street car line of Brazil, Ind., owned by Chicago and Brazil capitalists, has been sold to the Terre Haute-Brazil Electric Street Car Company for a consideration of $50,000. The purchasers contemplate connecting the line being built from Terre Haute to Brazil with their new purchase, making a continuous line from Terre Haute to Harmony.

The new officers of the General Railway Company, Chicago, have been chosen for the ensuing year. They are: President and treasurer, J. H. Witbeck; vice-president, James P. Black; secretary, Joshua I. Jones; general counsel, Charles L. Bonney; directors: James P. Black, C. L. Bonney, Lawton C. Bonney, Glenn E. Plumb, Lyman M. Paine, N. D. Lawton, J. H. Witbeck.

The Hagerstown, Md., Electric Railway held a meeting recently and elected the following officers: Christian W. Lynch, Harrisburg, president; William Jennings, Harrisburg, treasurer; W. C. Hepperlee, Hagerstown, secretary and superintendent; Donald C. Haldeman, Harrisburg, vice-president; directors: J. Irwin Bitner, J. Clarence Lane, Edward Mealey, all of Hagerstown, and the officers above named.

It is stated that the entire capital stock of the Columbus, Ohio, London & Springfield Electric Railway Company, $1,000,000, has been subscribed, largely by Boston men, and that it is expected the road will be completed within a year. Work will begin at once. The track will be standard gauge, rendering it necessary for the company to build an independent line in Columbus. Hart A. Fisher, a former well-known railroad official, will be the general manager.

A company has been organized for the purpose of connecting Milford, Upton and Grafton, Mass., by an electric street railway. The company will be known as the Milford, Upton & Grafton Street Railway Company. The length of the line is to be 12½ miles, and the capitalization of the company $125,000. The following subscribers to the articles of association will act as a temporary board of directors: Charles G. Bancroft, of Boston; John Kelly, of Somerville; Charles L. Cotton, of Dedham; H. D. Bowker, W. D. Leahy, H. E. Morgan, of Milford, and S. B. Fiske, of Upton.

The Speyer syndicate will loan the Third Avenue Railroad Company, of New York city, $17,000,000 at six per cent for three years, which will give the company time to double its property stock and with the new $17,000,000 stock take up the loan. The bankers receive a commission of two and one-half per cent, making the money cost the company nearly seven per cent per annum. The company is now earning but little more than the dividend it is paying on $17,000,000 capital stock because the result of construction expenditure which caused the floating debt has not yet been realized, as the work is still incomplete.

The contract has been let for the central power house of the Union Traction Company, to be built in North Anderson, Ind. The total cost of the building will be $83,698. The machinery has been bought at a cost of $675,000. The Indiana Bridge Company, of Muncie, got the contract for iron and steel work for $22,500, and O. L. Pulse & Company, of Greensburg, the other work and material for the building for $61,198. Work will be begun on the building at once, and it must be up by June. The machinery will be installed by July 1. The power house will supply power to all the interurban lines of the Union Traction Company and to the street railway systems of Anderson, Marion, Muncie, Elwood and Alexandria. It will be the biggest power house west of Niagara Falls, and in one sense is an interesting experiment. Power will be conducted as far west as Indianapolis, 36 miles; north to Marion, the same distance, and east to Muncie, 20 miles.

To the Front!

Under the above title the following energetic remarks appear as a leading editorial in our British contemporary, the *Electrical Engineer:*

"Truly we are a Berserk nation. It is in the blood, and the depth of the country's extremity is the height of her sons' opportunity. If we were to give an opinion of England's greatest need, at the present moment, it would be that we require a militant poet, also a militant statesman. We want speakers whose words will stir the hearts and strengthen the spirits—jubilant, fire-eating words, if you like, but nought that is of the croaking or lamely explanatory or excusing nature. So far as inspiring strains from poet or statesman are concerned, all we have had might be calcined in the furnace so far as rousing the national spirit is concerned. The present position is due solely to the temperament of the Anglo-Saxon, and that the country sounds with warlike din is because of the characteristic delight in battle that belongs to the race, and not from any action or word of leaders. The sinew of the country comes forward in the crisis and offers its services—nay, compels its services, though administrative efficiency at the War Office is unknown, nor is that effete establishment able to arm or control the masses of raw material at its command. This is left to private enterprise, to private organization, and mostly to private purses. However, something more is wanted than mere heads and hands, and at length the officials have accepted the proffered aid of hands controlled by educated brains. If any of the volunteers of the country can claim to be sufficiently educated and capable of utilizing the sciences of the century in the interests of the nation, surely the corps is that of the Electrical Engineers. We therefore congratulate the country in that a first detachment of 50 men and five officers have been accepted for the front, and leave as soon as the two sets of apparatus, including signaling and searchlight, are complete. The apparatus is specially designed, and will include all and the best of everything that can be of service. Major Crompton is also to be congratulated at the fine body of scientifically-trained men he will have under his command; and now a word for these men, who are leaving home and business to serve their country. They will do all that men can do; and may they be successful in their undertakings, returning safely and with credit to us who are left behind, and who have no greater delight than to be able to call them friends."

A New Through Telegraph Line from Budapest to London.

On December 4 direct telegraph communication was opened from the capital of Hungary, the granary of Europe, to London. Besides serving to gratify the national ambition of the Hungarians, it is explained by the editor of the *Magyar Nemzet,* the semi-official organ of Budapest, to be of immense value to the grain dealers there in their competition with the United States dealers for the Liverpool market, writes United States Consul F. D. Chester.

Hitherto, says this organ, it has taken three or four hours to transmit a message from London *via* Vienna or Berlin to Budapest, owing to the number of messages intended for those two places which had to pass over the same wire. The time required for replying to a message from London, therefore, amounted to six or eight hours, which meant the arrival in London of the reply to a request, say, for price of flour about 8 or 9 o'clock in the evening, when it was too late to decide in its favor; and the New York dealer, whose offer came in earlier, was always able to "make the deal."

Apart from this consideration, the advantage of the new telegraphic communication is clear from the following:

In the wheat growing season prices are determined in New York; but when the wheat is once stored and the consumption season of about 10 months sets in, prices are first quoted in Liverpool and are reported from there to New York. Hitherto, the noon telegram from Liverpool has arrived in Budapest about 4 o'clock, just as the bourse is closing, with the result that the quotation had almost no effect, while under the new conditions the exchange of telegrams between London and Budapest occupies only half an hour, and the effect on the bourse is felt.

The work of carrying through the new telegraphic communication devolved upon Hon. Peter Szalay, chief of the postal telegraph section in the Hungarian Ministry of Commerce, who began negotiations with the British consul-general in this city in 1896. By dint of successful arrangements with Austria, Switzerland and France, the matter was accomplished. It is generally regarded in Budapest as a long step towards the occupation by Hungary of that position which a country so rich in agricultural and mineral resources should occupy.

At the semi-annual meeting of the directors of the Wilmington, Del., and Newcastle Electric Railway, a dividend of two per cent was declared.

The Electric Light Plant at Pretoria.

Electric light was introduced in Pretoria eight years ago, when small belt-driven dynamos were installed for the purpose. These machines, which formed the original plant, are still effective for use, and consist of five Crompton continuous-current bipolar dynamos designed for 120 volts and 320 amperes and a speed of 770 revolutions a minute. Each machine is belted to a Davey Paxman horizontal compound engine, working at 140 pounds steam pressure and capable of exerting 75 horse-power at a speed of 120 revolutions a minute. The engines are supplied with steam from a battery of five Davey Paxman 30-horse-power locomotive boilers, the gases from which escape by one main flue to a brick smoke-stack about 60 feet high. A Crompton switchboard, with a suitable arrangement of switches, voltmeters and ammeters, and a light overhead traveler may be said to complete what is now termed the "old plant." The "new plant" was installed about two years ago by Messrs. Hubert Davies and Spain, and the generating portion consists of two 126-kilowatt generators, designed for 260 volts' pressure. These are coupled direct to two Bumstead and Chandler compound-condensing engines, working under a steam pressure of 160 pounds, and running at 340 revolutions a minute. The cylinders are: Low pressure, 22 inches; high pressure 14 inches, and stroke, 9 inches. All the working parts of the engine, excepting the Chandler governor, which is operated off the crank shaft, are entirely enclosed. Each engine is provided with forced lubrication, an engine counter and a Giepel steam trap. Two equalizers are used. One is wound for 120 amperes at 120 volts, and the other, made by Siemens & Halske, is of similar capacity. A separate switchboard serves the new plant. The main cables from the generators are laid underground throughout the town, and consequently no trouble is experienced from lightning shocks. Thomson-Houston lightning arresters are used where necessary, however. The cables now in use are steel-armored, in the place of lead covered, which were at first tried, but did not prove entirely satisfactory owing to their too rapid depreciation. The present cables, on the other hand, are giving satisfaction.—*Industries and Iron.*

At the annual meeting of the Findlay, Ohio, Street Railway Company, G. B. Kerper, of Cincinnati, was elected president; C. D. Kinney, of York, Me., vice-president, and C. F. Smith, of Findlay, manager.

INDUSTRIAL NOTES

Joseph Dixon Crucible Company, Jersey City, N. J., are sending out an appropriate calendar blotter for February.

The Sterling Electric Company, Chicago, have removed their offices from 71 and 73 West Adams street to 1260 Monadnock Building.

Charles H. Elliott Company, of Philadelphia, the well-known engravers and art printers, have issued a handsome steel engraved wall calendar.

Uehling, Steinbart & Company, Ltd., Carlstadt, N. J., are sending out a handsome catalogue entitled "The Control of Heat," in which their new type of pneumatic pyrometer is illustrated and described.

The Partridge Carbon Works, Sandusky, Ohio, is sending to its friends and customers a neat wall calendar with a handsome engraving of Niagara Falls, and advertising in an effective manner the well-known Partridge self-lubricating motor brush.

The Chicago Pneumatic Tool Company, Chicago, Ill., has sent to the ELECTRICAL REVIEW a special edition of its catalogue No. 6, illustrating and describing riveters, hammers and drills operated by compressed air. The same company has also sent to us a "Pictorial History of the Locomotive from 1771 to 1899," which shows graphically, and in a very interesting manner the progress of locomotive construction.

The Westinghouse Electric and Manufacturing Company is at present doing the most enormous business of its history and orders are being turned out at the East Pittsburgh shops aggregating $1,500,000 a month. The officials say that the company is making much more and that the present year will represent the most prosperous in its history. Orders are on hand for about two years to come and contracts are being closed continually. The foreign business is the greatest ever experienced.

The New York Air Compressor Company, 120 Liberty street, New York city, has issued a new catalogue of its air compressors designed for all the uses of compressed air power. The catalogue contains useful information and tables, and should prove to be valuable as a book of reference to all interested in the subject. This catalogue will be followed shortly by a more elaborate and voluminous one now in the course of preparation. All of the literature issued by this company is mailed without charge upon application to its main office, 120 Liberty street, New York city.

The Cling-Surface Manufacturing Company, of Buffalo, N. Y., has just been incorporated under the laws of the state of New York, retaining the same name as heretofore, with Albert B. Young as president and general manager and Wm. D. Young, vice-president and secretary. The past year has been the most prosperous in the history of the company and the demand for "Cling-Surface" they report to be increasing steadily. They have now three branches, one each in Boston, New York and Chicago, with others just opening in St. Louis and New Orleans, while the well-known importing house of W. J. Moxham & Company, of Sidney, Australia, has ordered a large shipment of "Cling-Surface" with the exclusive right to handle it in Australia.

The Mississippi Valley Telephone Company, Minneapolis, Minn., has recently placed an order with the Stromberg-Carlson Telephone Manufacturing Company, Chicago, for the complete equipment for a branch exchange in St. Paul and also additional equipment for increasing the Minneapolis exchange, which is being made up and furnished as rapidly as possible. While the completion of the two exchanges has been somewhat delayed, owing to the scarcity of raw material, it is, however, progressing as rapidly as can be expected in a system of the extent of the two plants. The two exchanges, when completed, will represent an investment of more than a million dollars, and all the capital has been furnished by J. C. Hubinger, "America's Starch King," of Keokuk, Iowa. These plants, when completed will, it is stated, be the largest individual telephone holdings in the independent field. The plants are constructed first-class metallic throughout and are equipped with the S.-C. "Central Energy" system and multiple switchboards. Both the Minneapolis and St. Paul exchanges are now in operation and the plants are being rapidly extended.

LITERATURE

"Telephone Inspector's Handbook: Telephone Troubles and How to Find Them." By W. H. Hyde and J. A. McManman. Paper, 70 pages, numerous illustrations. Price, 25 cents. Supplied by ELECTRICAL REVIEW, 41 Park Row, New York city.

This extremely valuable book, which was formerly known as "Haskin's Telephone Troubles," has run through six large editions and is now in a new, seventh edition. It is the most popular book of its sort and is already in every day use in all parts of the United States.

"American Institute of Electrical Engineers' Handbook for 1900."

The handbook of the institute contains the usual amount of interesting historical matter, which is marred by the extraordinary and illegible typography in which it has been set forth. The book also contains a full list of members and associate members which are well indexed and classified, a classified list of papers read before the institute, and the report of the Committee on Standardization recently adopted.

"Condensers." Published by The Power Publishing Company, New York. Limp boards, 80 pages, numerous illustrations and tables. Supplied by the ELECTRICAL REVIEW at 50 cents.

This monograph does not treat of electrical condensers, but of steam engine condensers, and consists of a series of lectures and articles upon the subject reprinted from the columns of *Power.* It is a good, practical, concise treatise and is worthy the careful study of all users of steam engines and of all who desire to understand thoroughly the handling and manipulation of these machines.

"Small Accumulators: How Made and Used." By Percival Marshall. Eighty-two small pages, 40 illustrations, cloth. New York, Spon & Chamberlain. Furnished by the ELECTRICAL REVIEW at 50 cents.

This little book calls itself an "elementary handbook for the use of amateurs and students." It describes in brief the theory of the accumulator, tells how to make four-volt and twelve-volt accumulators and various other types of small storage cells, and is written in such simple language that any intelligent person will find no difficulty in understanding it and using it. The chapter of useful receipts and the glossary of technical terms are both valuable additions.

"Signaling Through Space Without Wires: Being a Description of the Work of Hertz and his Successors." By Professor Oliver J. Lodge. Third edition. The Electrician Publishing Company, London. Cloth, 134 pages, 66 illustrations. Supplied by the ELECTRICAL REVIEW at $2.00.

Professor Lodge's position as a writer upon technical subjects is peculiarly pre-eminent, not only on account of the authority with which he speaks but as well because of the beauty of the English in which his remarks are clothed. The book consists of a lecture on the work of Hertz (delivered in 1894 and revised to date by the author), which forms about one-quarter of the subject matter of the book, and a large number of short notes and appendices on recent work of Lodge, Hughes, Branly, Ducretet, Thomson and others, and also some chapters on photo-electric researches and polarized electric radiation. It is an admirable addition to electrical literature.

The Columbus, Ga., Power Company has increased its capital stock from $200,000 to $300,000, this being decided upon at a meeting of the stockholders in Savannah. The additional stock—$100,000—has already been subscribed. The original stock of the company was $100,000 and it was increased to $200,000 and now the magnitude of the enterprise makes necessary this further increase. Treasurer G. Gunby Jordan said recently that the power plant of the company would probably be complete by May 1.

ADVANCE INFORMATION

Electric Light and Power.

HARRISBURG, PA.—The West Brownsville Electric Light, Heat and Power Company, of West Brownsville, Washington County, has been incorporated with a capital of $5,000.

HARRISBURG, PA.—The Brownsville Electric Light, Heat and Power Company, with a capital stock of $12,000, has been incorporated.

HARRISBURG, PA.—The Bridgeport Electric Light, Heat and Power Company, of Fayette County, with a capital of $12,500, has been incorporated.

CAMDEN, N. J.—The Consolidated Electric Company has been incorporated with a capital of $100,000, by S. R. Ketcham, Charles F. Lumb and G. H. B. Martin, to carry on an electric light business.

VANCOUVER, B. C.—The Canadian Government has granted the application of a company of New Yorkers who have a plan to utilize the tide power in the narrow entrance to Vancouver harbor. The water flowing in from the Pacific Ocean through this narrow pass reaches a high velocity at a certain stage of the tide. With this power a big electric plant is to be operated to supply electricity to the city a mile away.

ALBANY, N. Y.—Certificates formally merging six concerns into the New York Gas and Electric Light, Heat and Power Company, of New York city, have been filed with the Secretary of State. The merged concerns were the Block Lighting and Power Company No. 1, the Borough of Manhattan Electric Company, the Manhattan Lighting Company, the Mount Morris Electric Light Company, the New York Heat, Light and Power Company and the North River Electric Light and Power Company. The New York Gas and Electric Light, Heat and Power Company was recently absorbed by the Consolidated Gas Company, of New York city. The capital stock of the several companies absorbed was: North River Electric Light and Power Company, $400,000; New York Light, Heat and Power Company, $375,000; Manhattan Lighting Company, $250,000; Mount Morris Electric Light Company, $1,500,000; Block Lighting and Power Company No. 1, $98,000; Borough of Manhattan Electric Company, $1,000,000. Total, $3,623,000.

NORTH HEMPSTEAD, N. Y.—Roslyn Light and Power Company, to manufacture electricity for light, heat and power purposes in the town of North Hempstead, Nassau County. The capital is $50,000 and the directors are: R. D. Winthrop, of Westbury; C. H. Mackay, of Roslyn, and E. D. Morgan, of Newport, R. I.

ST. LOUIS, MO.—The Guernsey Incandescent Light Company filed articles of incorporation Monday with a capital stock of $100,000. The incorporators are: David W. Guernsey, S. T. Price, Joseph G. Branch, Charles W. Barstow, Jr.

Telephone and Telegraph.

NEW YORK CITY—The Western Union Telegraph Company last week practically concluded negotiations for the sale of $20,000,000 four and one-half per cent bonds to a syndicate. The bonds are to be used partly to take up bonds maturing soon, which bear higher interest, of which bonds there are some seven millions, and partly for extensions and improvements. Russell Sage is quoted as saying that the new bonds were not to be issued to purchase any other telegraph or telephone company.

SMITH CENTRE, KAS.—The Exchange Telephone Company. The capital is $5,000; directors are: J. R. Burrow, W. H. Nelson, F. W. Mahire, W. B. Slagle, Henry Williams.

TOPEKA, KAS.—The St. John Telephone Company; capital stock, $2,000; directors: John Thompson Gray, P. W. Thompson, O. B. Shepard, A. Aitken, Paul R. Nagle, G. W. Grandy and F. B. Gilmore, all of St. John.

BELLE PLAIN, N. J.—Enterprise Telegraph and Telephone Company. Operate telephone line. Capital, $20,000; incorporators: E. B. Goodwin, W. Goodwin, C. M. Goodwin, all of Millville; L. M. Hess, R. B. Hess, both of Belle Plain.

MILWAUKEE, WIS. — The American Wireless Telegraph Company has been incorporated; capital, $1,000,000; by Warren S. Johnson, C. L. Fourtier and Henry Herman. The former two are inventors of a system of wireless telegraphy.

HARRISBURG, PA.—A charter has been issued by the State Department to the Telephone, Telegraph and Cable Company, of Pennsylvania, to operate in all the counties of the commonwealth; capital, $25,000.

Miscellaneous.

TRENTON, N. J.—The Electro-Chemical Light and Heat Company, capital $1,000,000, has been incorporated by Fred C. Dowd, James L. Gethins and P. A. Dowd.

CHARLOTTE, N. C.—A new electrical company, to be known as the S. B. Alexander, Jr., Electrical Supply Company, has been incorporated with a capital of $25,000, all of which is paid in. The incorporators are J. F. Robertson, S. B. Alexander, Jr., and M. E. Robertson. The company will begin business at an early date.

LOS ANGELES, CAL.—Boyle Heights Electric Company. Electrical business. Capital, $100,000; incorporators: W. B. Palmer, W. C. Pelchner, D. E. Skaggs, J. Adams, C. M. Buck, all of Los Angeles.

BALTIMORE, MD. — The Chesapeake Electric Company has been incorporated for the purpose of doing a general electrical business in contract work, the manufacture of electricity and supplies. The capital stock is $20,000. The incorporators are: Benjamin C. Howard, Allan M. Cohen, Eugene Greenway, Jacob I. Cohen and Francis T. Horner.

TAMPA, FLA.—The Tampa Electric Company has filed for record a mortgage for $500,000 in favor of the American Loan and Trust Company, of Boston. The mortgage is to cover the interest on bonds to be sold to raise money for important necessary improvements.

NEW YORK CITY—The United Metal Selling Company has been organized under the laws of New Jersey, with a capital of $5,000,000, and the following directors: William Rockefeller, H. H. Rogers, C. C. Beaman and Leonard and Adolph Lewisohn, of the firm of Lewisohn Bros. The copper business of the Lewisohns will be taken over by the new company, which will operate as a central selling agency for the product of the several mines, concentrating the metal interests of the concern under one management.

Electric Railways.

EATON, OHIO—Richmond & Eaton Traction Company. Build and operate street railroads. Capital, $12,000; incorporators: A. Emanuel, S. A. Price, H. O. Cox, J. Weil, H. B. Pruden.

YORK, PA.—York Traction Company. Traction company and furnishing electricity. Capital, $100,000; incorporators: W. H. Lanius, G. Hersh, W. F. B. Stewart, G. S. Millmeyer, J. W. Steacey, all of York.

MONTREAL, QUE.—The Mount Royal Park Incline Railway Company have appointed a committee consisting of Messrs. Mann, Valance and Turner, to confer with electrical companies as to the conversion of the power plant from steam to electricity.

TORONTO, ONT.—The Niagara, St. Catherines & Toronto Railway Company will build an electric line to Hamilton.

WOODSTOCK, ONT.—The Woodstock Council has refused a 50-year franchise to an electric railway between this town and Ingersoll.

NEWARK, OHIO—A franchise has been granted to the Columbus, Buckeye Lake & Newark Traction Company by county commissioners.

BUFFALO, N. Y.—The Dunkirk and Hickoryhurst Traction Campany, a Buffalo company who offered $6,000 for a franchise to build a street railway to Point Gratiot Park, have been given final notice that if their propositions are not made good before the expiration of two weeks, all negotiations will be at an end. If they refuse to comply, a similar franchise will be granted to an original company made up of local capitalists. The presumption is that they will cheerfully abide by the decision of the Common Council and fulfill all the necessary obligations.

ELECTRICAL PATENTS

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED FEBRUARY 6, 1900.

642,570 Underground electric railway; W. J. Baumer, Johnstown, Pa.

642,599 Dynamo-electric machine; H. Geisenhoner, Schenectady, N. Y.—A punching for a dynamo-electric machine, consisting of a main body portion with a number of teeth or projections, each of the teeth or projections being provided with a strengthening rib.

642,615 Dynamo electric machine; C. W. Kragh, Madison, Wis.—A motor and an end piece provided with a bearing for the motor-shaft and having projecting legs suitably spaced around said bearing and projecting beyond the bearing, the motor being supported upon said legs.

642,623 Hanger for electric lamps; W. F. Murphy, Iowa City, Iowa.

642,627 Electric-lighting system; A. C. M. Prucker, Hanover, Germany.

642,648 Electric lighting device; G. W. Van Duzer, Hackettstown, N. J.

642,662 Apparatus for electrically transmitting orders or signals; A. U. Allcock, London, England.

642,674 Electrical recording apparatus; H. L. Callendar, Montreal, Canada.—A bridge wire, a contact movable along it, a recording device, carried by the contact, a galvanometer, means for connecting its poles to the bridge-wire and to the contact, and means actuated by the galvanometer for traversing the contact.

642,697 Electrical track for receptacles; C. Hutchinson, Arlington, N. J.—Consists of the motor, the wire conductor, the rails and contact strip, current-reversing means operated at any desired point of the track.

642,737 Electric railway; Eduard Bonney, Lyons, France—A car having a magnetized bar, and an energizing coil for imparting additional magnetism to said bar, said coil being in series with the motor and receiving the full current passing in the motor.

642,738 Electric cable for high-tension currents; C. Borel, Lyons, France—Comprises a cylindrical central core or conductor composed of a plurality of wires bare and in contact with each other, a plurality of exterior wires encircling said core and slightly insulated therefrom, and a thin insulating-covering around said outer wires, all of said wires conveying the same current.

642,743 Commutator for electric motors or generators; S. Evershed, London, England.

642,800 Telephone switchboard; E. T. Yaxley, Chicago, Ill.—An annunciator-magnet having a drop-actuating plunger, an annunciator-drop having a strip of insulating material inserted in its rear side to be engaged by said plunger.

642,825 Socket for incandescent electric lamps; W. E. Oetting, Pittsburgh.

642,826 Carbon for electric arc lights; J. T. Robinson, New York, N. Y.—The process of treating carbon electrodes for improving their quality, which consists in soaking them bodily in a compound solution obtained by subjecting talcous asbestos to the dissolving action of a solution of caustic alkali.

642,844 Push button for battery indicators; G. Heidel, St. Louis, Mo.

642,848 Railway signal mechanism; S. L. Neely, Pierron, Ill.

642,849 Electrical massage instrument; E. T. Otto, Jersey City, N. J.

642,879 System of electrical distribution; H. P. White, Kalamazoo, Mich.—A phase displacer for use in an alternating-current circuit, consisting of a plurality of parallel coils corresponding to the number of circuits to be acted upon so that the amount of resistance and induction shall be equal.

642,880 Connection-register for telephone-lines; C. E. Scribner, Chicago.

642,881 Toll-collecting apparatus for telephone pay-stations; C. E. Scribner, Chicago, Ill.

642,911 Electric lamp support; H. Long, Greentown, Ind.

642,932 Electric current controlling mechanism; C. W. Squires, Springfield, Mass.—A magnet and its armature, a circuit-changing switch, comprising a circuit-changing disk and contacts with which said disk co-operates, operated by said magnet and its armature, and circuit-conductors comprising said contacts and coils of said magnet and suitable feed and return wires.

642,933 Electrolytic separating of zinc from zinc oxid; O. J. Steinhart, London, England.

642,934 Telephonic instrument; F. A. Swan, Boston, Mass.

642,953 Electric battery; H. Blumenberg, Jr., New York, N. Y.

642,982 Mouthpiece for telephone transmitters; G. B. Hart, Rochester, N. Y.—Consists of a tubular wall, a tubular support for a disinfectant arranged within the tubular wall, a perforated frame inserted within the tubular support and movable lengthwise independently of the support.

642,995 Electric connecting device for lamp holders, wall-plugs, etc.; C. L. R. Menges, The Hague, Netherlands.

643,000 Brush holder; P. O'Shaughnessy, New York, N. Y.

643,002 Electric igniter for explosive engines; W. J. Perkins, Grand Rapids, Mich.

643,018 Utilization of Hertzian or similar radiations and apparatus therefor; L. H. Walter, London, England.

643,066 Alternating-current motor; W. Langdon-Davies, London, England.

643,087 Electric generator for sparking apparatus of gas engines; Dan. Drawbaugh, Eberly's Mills, Pa.

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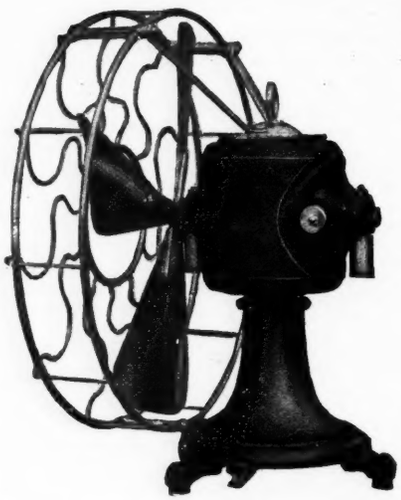

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